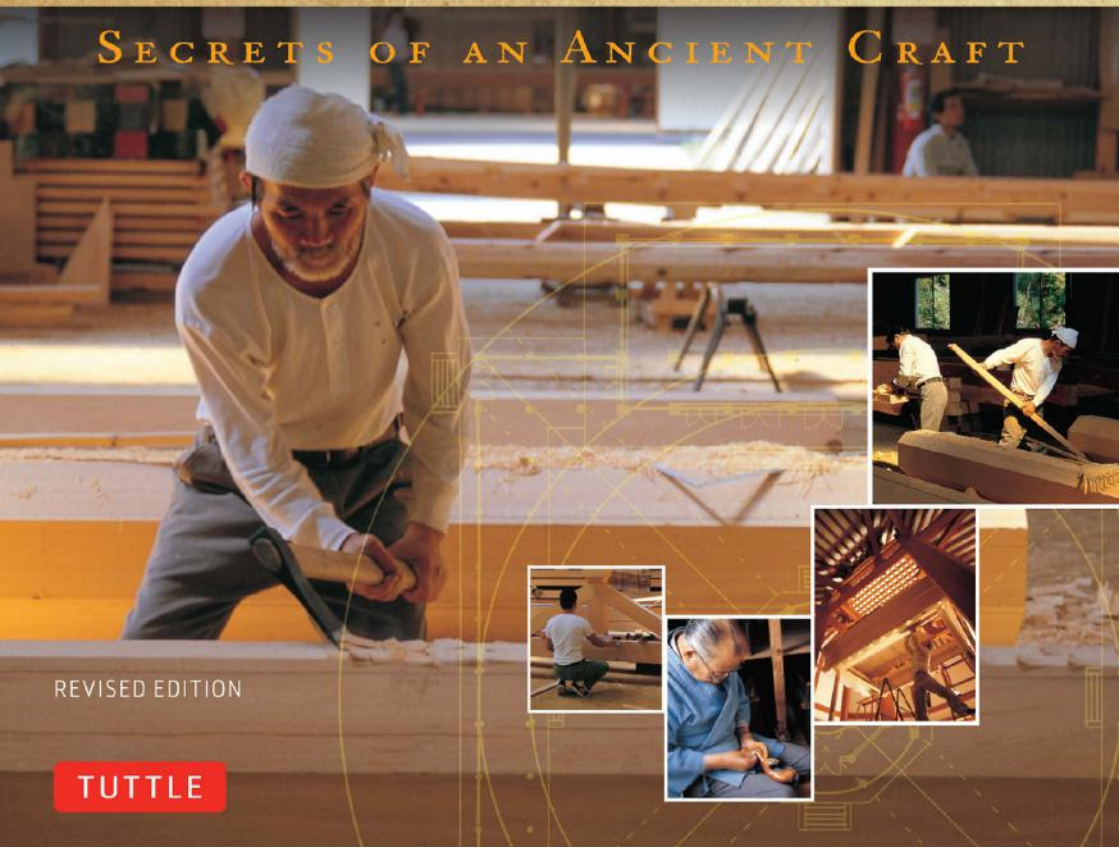
AZBY BROWN

THE GENIUS OF JAPANESE CARPENTRY

SECRETS OF AN ANCIENT CRAFT



REVISED EDITION

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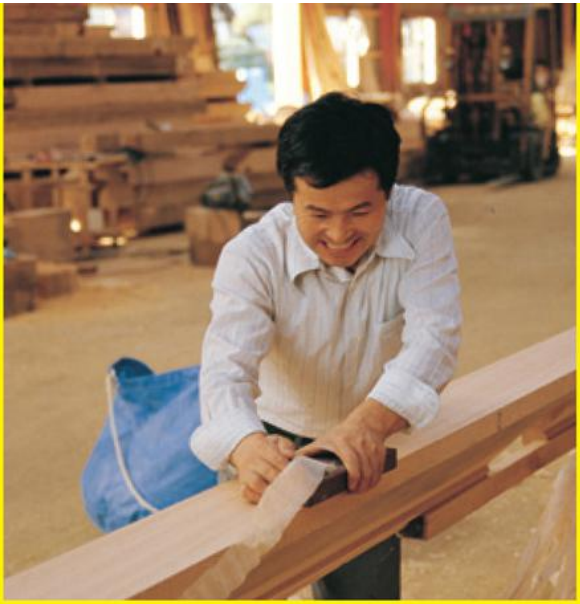

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Over 1,200 years ago in the ancient Japanese capital of Nara, anonymous carpenters erected a number of intricately designed timber temples and pagodas for a new Buddhist monastery known as Yakushiji. Then, as now, these buildings were considered marvels of architectural elegance and traditional Japanese craftsmanship. One of the ancient pagodas still stands, testimony to the great skill and dedication of its ancient builders. The same skills and dedication are very much in evidence today in the work of modern-day Japanese master carpenters who combine the timeless past with the living present in their everyday lives.

Constructed in the eighth century and subject over time to the depredations of fire and warfare, the Yakushiji monastery has been undergoing extensive reconstruction that sees it now almost fully restored to its original appearance. Newly constructed buildings have been erected employing the original methods, architectural styles, and much the same woodworking technology as their predecessors. Author Azby Brown spent years at the site, at the

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Figure 1 Corner bracket assembly of the Yakushiji Lecture Hall (daikodo).

Figure 2 Tsunekazu Nishioka, regarded as the last of the great master temple carpenters in Japan, photographed in 1986.

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TUTTLE Publishing
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In Memory of Maya, Verena, Uri and Master Nishioka

Except where otherwise noted, all photographs and illustrations are by the author.

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From the 1989 edition:
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My sincerest gratitude goes also to the many people who have made my long stay in Japan not only possible but enjoyable, particularly Professor Hisao Koyama of the University of Tokyo, who generously gave me permission to pursue this study as part of my graduate work, and without whose encouragement and assistance any extended stay in Japan would have been impossible. Thanks are due also to the many organizations upon whose assistance I have relied, particularly the Japanese Ministry of Education, the Japan Foundation, and the Ikeda Construction Company, and to those who made my first trip to Japan possible, especially Atsushi Moriyasu, who shares a deep interest in this subject and who, five years ago, surely could not have foreseen this

tangible end result of a good word placed with the right people at the right time.

Finally, to Lynne E. Riggs and to everyone at Kodansha International, particularly editors Michael Brase and Shigeyoshi Suzuki and designer Shigeo Katakura, whose selflessness and unflagging energy have buoyed me up through the seas of exhaustion.

For this revised edition:
To the above I would like to add my gratitude to Director Yuji Yamazaki and the staff of Uzumasa Films for involving me, even in a small way, in their fantastic film about Nishioka, Oni ni kike [An Artisan's Legacy: Tsunekazu Nishioka], and for providing the photograph on page 12. Thanks to my colleagues at Kanazawa Institute of Technology for accepting the amount of time I have devoted to this edition, and particularly to Miyako Takeshita, curator at my lab in Tokyo, the KIT Future Design Institute, who assisted in many aspects of research and production. Finally, to Eric Oey, June Chong, Alphone Tea, and the many others at Tuttle for their efforts in seeing this challenging book completed in a form we all can be proud of.

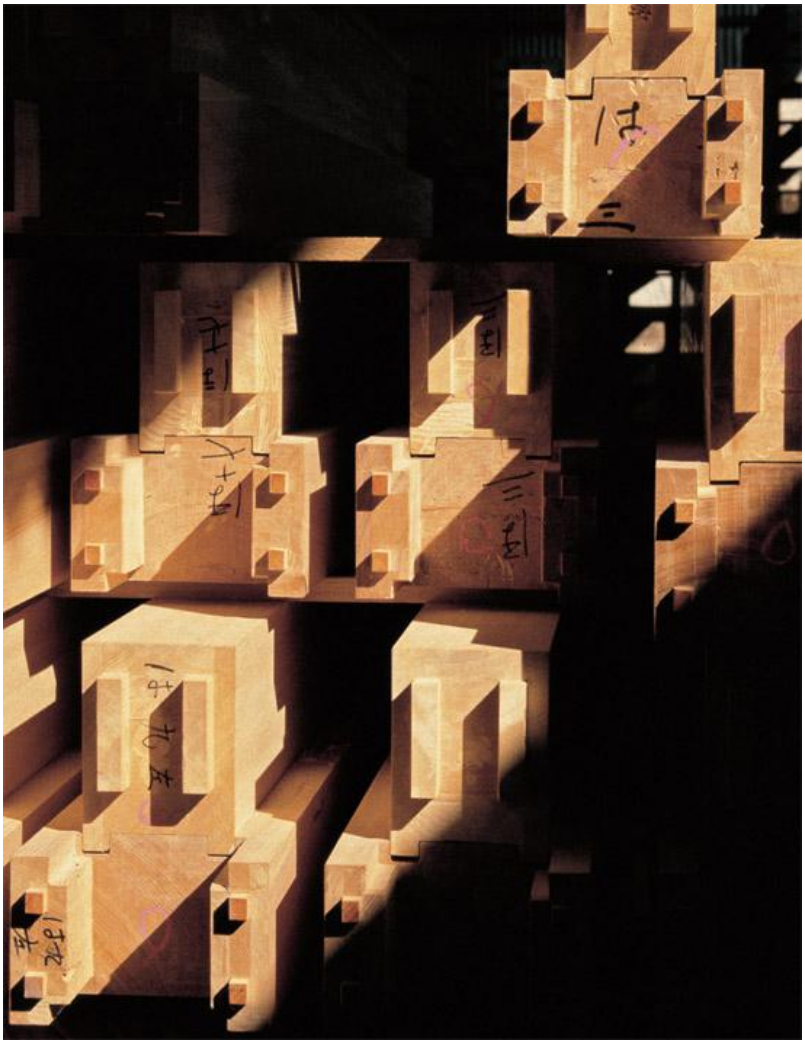

Figure 3 Completed door frames await assembly. (See also Figs. 71, 136, 137.)

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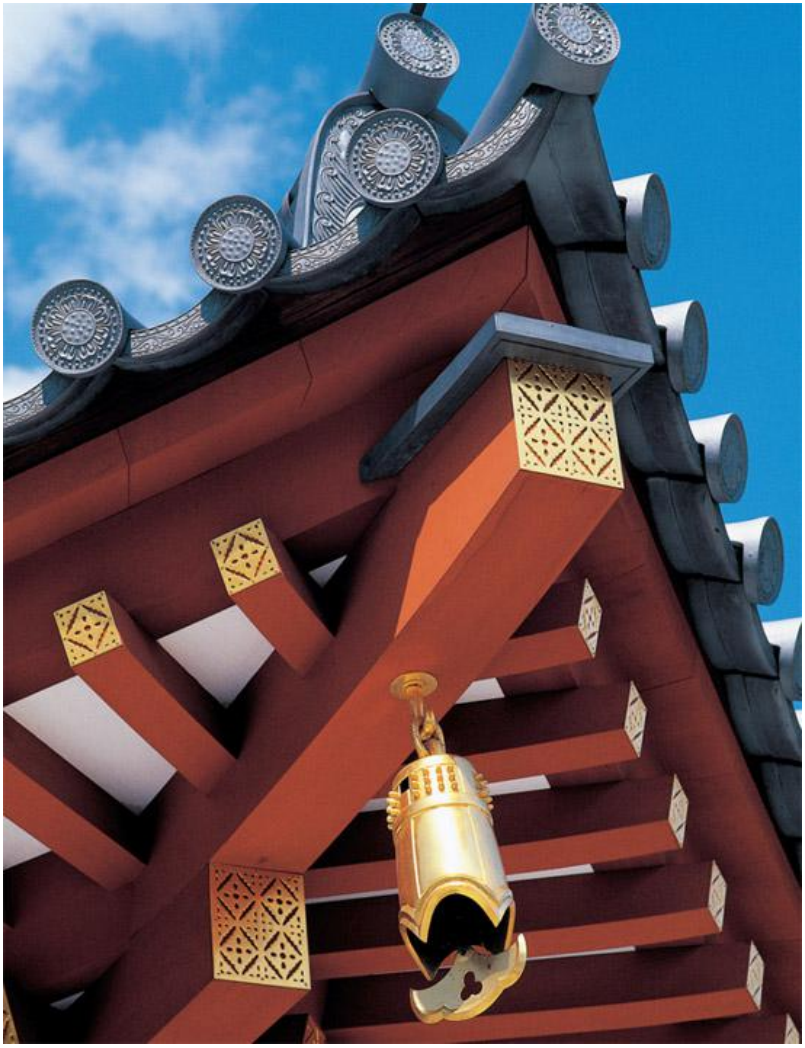

Figure 4 Corner detail of the completed Yakushiji Picture Hall (E-den).

THE GENIUS OF JAPANESE CARPENTRY

Twenty-four years have elapsed since the first edition of this book was released in 1989. Working on a new edition of a book that meant so much to me after an interval of more than two decades has been a rare opportunity for revisiting an extremely formative period of my adult life, for reevaluating my earlier ideas and ideals in light of what I have learned and experienced since that time, for reconnecting with people, with Nara and Yakushiji, and for correcting a (thankfully small) handful of mistakes. It has meant reliving the years I was in contact with Master Nishioka and the countless hours I spent in his workshops and on his building sites, as well as the months taken up with producing the first edition of this book, my first book ever, and reconsidering the many decisions I made about how to best tell the story. More than anything, however, it has meant reflecting on the many changes that have occurred at Yakushiji, in the world of Japanese temple carpentry, in Japanese society, and in myself.

The biggest single change is that Tsunekazu Nishioka died in 1992, just a few years after this book was first published. The buildings in the Sanzō-in subcompound of Yakushiji were almost fully complete by then, and one of Nishioka's last official acts as master carpenter of the Yakushiji complex was to officiate at the ceremony commemorating the placement of the first column of the reconstructed surrounding corridor of the main temple complex. Nishioka made a special trip from the hospital where he was being treated for cancer in order to participate. Years earlier, I had already had an inkling that Nishioka was in a race with death, and perhaps that was reflected in some of what I wrote then. He was already in his

mid-eighties when we first met, and was planning work which he expected would require two or three decades more to complete. I remember one day, in particular, when our discussion turned to time, and he pointed out how brief a human lifespan was compared to the thousand or more years of a living tree or of a well-built temple, and how that sense of perspective guided his work. On his desk was a familiar pad of gridded paper on which he was calculating dimensions for the reconstruction of the Great Lecture Hall (Daikodo), a very large building whose commencement still lay years in the future. Nishioka expected it would take nearly a decade alone to find suitable timber. Not quite sure that I was understanding correctly, I asked him, "So you're preparing everything so the work can be carried out even if you're not here?" Whereupon he grinned and said simply, "Of course."

And it has been. Under the guidance of Nishioka's chief apprentice, Mitsuo Ogawa, the Great Lecture Hall, the largest building at Yakushiji, was completed in 2003. It is spectacular and overwhelming in its size, grace, and beauty, and I truly regret not having been present during its construction. And there the project has basically stopped. At the time of this writing, the 1,300-year-old East Pagoda is undergoing its 100-year maintenance, being carefully disassembled and checked for signs of damage. This work is scheduled to take until 2018. Half of the surrounding corridor has been completed, and there are no immediate plans to complete the rest. Nishioka drew plans for a new bell tower and sutra repository, but no preparations appear to have been made for that work, nor for the remaining monks' living quarters. So, in fact, those who visit Yakushiji today will probably see all that will ever be built there. The

reconstruction project seems to have ended a decade or so sooner than Master Nishioka had intended.

Figure 5 A corner of the Picture Hall under construction, viewed from inside.

The Picture Hall (E-den), the construction of which this book describes in detail, was designed to have religious murals on its expansive interior wall surfaces, transforming the building into a space for contemplation, reflection, and religious education. The painting of these murals was entrusted to Ikuo Hirayama, one of the most highly regarded painters in the contemporary "Nihonga," or "Japanese painting" style. This style of painting uses traditional organic and mineral pigments, and while some of its practitioners hew closely to antique styles of imagery, others, like Hirayama, became known for a looser, more personal style. Hirayama, who accepted no fee for this work, made dozens of pilgrimages to Buddhist sites along the Silk Road, and inspired by what he saw and experienced there, he envisioned a series of wall

panels based on mystical mountains taken from Buddhist lore, with ceiling panels of lapis lazuli flecked with gold-leaf lotus petals and images of the sun and moon. He completed this monumental series in 2001. It was his life's work, and he wrote very feelingly that he intended the works to be a spiritual experience for viewers. Hirayama died in 2009. It is a bit painful to note that the E-den was used as intended for only a few years, as an open space that could accommodate groups of worshipers as well as solitary seekers who could immerse themselves in the visually evocative surroundings. But full-height glass walls were soon erected along the line of inner columns, and a climate control system installed to further protect the paintings, forcing viewers to file through and view them from several meters away. I am certain that if Nishioka were alive, he would have vigorously opposed these measures, and I expect that Hirayama would have as well, as would have the late Abbot Kōin Takada, whose enthusiasm gave birth to the Yakushiji reconstruction project and to the Sanzō-in as well, and who personally asked Hirayama to undertake the murals. These three men were each greats in their spheres, and each struck me as a person of deep understanding and vision. Where what they have accomplished together at Yakushiji is exquisite, it is because each enabled the others to realize their highest ideals. Vision like this rarely survives its possessor.

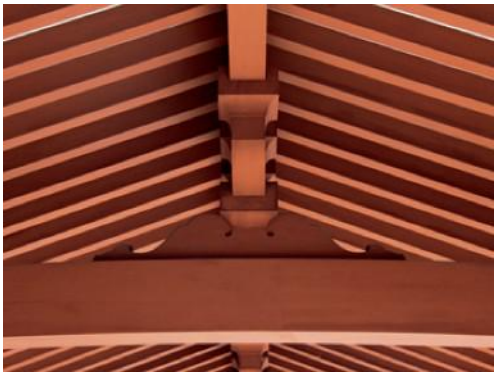

Figure 6 Detail of the beams and rafters of the Sanzō-in cloister, or surrounding corridor.

Of the many changes I have observed since 1989, one of the most gratifying, though puzzling, is the growth of Nishioka's reputation since his death. When I was studying with him, I rarely encountered people who were aware of him and his work, and those that were tended to be specialists in temple construction or historical preservation, or otherwise involved in related fields. At the time, it was painful to see how extremely under-appreciated the field of Japanese carpentry was in its home country in general, and temple carpentry in particular.

Nishioka struggled with misconceptions and criticisms while alive, being called to defend the cost of his projects and the time required to complete them, and to justify on social and ideological grounds what skeptics considered a dangerously backward-looking approach to culture. So the growth of his reputation and the vastly increased awareness of his work in Japanese society at large since his death brings with it a twinge of irony. But it cannot be denied that his name and the

significance of his life's work are now familiar to a much wider public than they were when he was alive and sought support. Nishioka is now legendary at home. He wrote several books during his lifetime, and all of them continue to sell well. He is the subject of an excellent and well-received documentary released in 2012, for which I was happy to contribute texts and to participate in public discussions. There is a well-run study group devoted to his work and thinking, and many of the tools and notebooks that laid on his desk or on shelves in his workshop when I visited him are now in the excellent Takenaka Carpentry Museum in Kobe. Witnessing this apotheosis, and thinking back to the 1980s, I remember vividly how bewildered I was that no one seemed to know or care that such a person existed. But I also recall that the man who sat before me so often telling stories about his youth, or who took time out to walk around the old buildings at Yakushiji, pointing out what was well or poorly done, was, more than anything, patient, kind, humble, and always quick to laugh.

That period of encounters with Nishioka changed me in ways I have only begun to fully appreciate. I probably would not have been as receptive to him personally if he had not been such a normal and unassuming human being. And I want to stress that although I declined his offer to become a carpentry apprentice, fearing, with justification, that my personality was not suited to years of unquestioning obedience, he made a place for me among those he was teaching, and found ways to teach me what I was ready to know. In the process, he gave me my life's work. I treasure several letters and postcards he wrote to me, always in brush and ink, particularly a note of congratulations he sent me after the publication of The Genius of Japanese Carpentry. He had addressed it to "Azby

Brown, Sensei," in effect anointing me as a teacher in my own right, though I was still young and only a graduate student. That meant more to me than anything because I had not sought it, nor had I expected it. And as honors often are, it was also a less than subtle nudge and a challenge to improve upon what I had already done. I have often said that I wrote this book partly to repay the immense debt I owe Master Nishioka, as a student to a teacher. And now, more than twenty years later, I realize that this debt is never really repayable.

Figure 7 A carpenter works out interior details of the Sanzō-in Octagonal Hall.

Among the ways that Nishioka gave me what has become my life's work was the opportunity the experience provided to learn about the process of making books, which was a very new avenue for me at the time. In particular, I realized that to do the subject justice I would need to present descriptive text, good photos, and well thought out drawings together. I shot

over 1,000 photos of various aspects of the work at Yakushiji, most of them in black and white due to the cost of film and processing, made quite a few sketches of the various elements and connections, and was given an excellent set of plans. Master Nishioka also allowed me to make xerox copies of his detailed notebooks of drawings and measurements. Despite my architectural education, I still had to teach myself how to make clear exploded-view drawings of the structural assembly process with its dozens of complex joints. I remember that hot summer well, sitting on the floor in my non-air conditioned room in Tokyo, a towel wrapped around my head to keep dripping sweat from spoiling my inkwork. I saw lots of room for improvement then, and see even more now, but as time has gone on I have developed something of a knack for that kind of drawing, and have used it in each of my books since then. The desire to convey Nishioka's work clearly turned me into a writer and an architectural illustrator of sorts, and even when my subjects have been contemporary buildings I find that the effort I expended honing my three-dimensional visualization skills back then has stood me in good stead.

Whenever we spoke, Master Nishioka managed to frame issues in terms of time and the environment, particularly calling attention to how things like wood change as the years pass. The fundamental environmental soundness of traditional Japanese carpentry practice, and the awareness and sensibility they reflected, made a lasting impression on me, and in some ways became the keystone of all my later work. That and the sense of continuity spanning ages has informed my design and other creative work as well as my writing. And after over a decade investigating modern and contemporary Japanese architecture, it was this ember of awareness that led me to

return to these core themes several years ago when I renewed my research into the sustainable practices upon which traditional Japanese crafts and lifestyle were based for what became a book called Just Enough. That book very neatly bookended this one, and it feels to me like the culmination of decades of study that began here, in Nara, with Master Nishioka. I have received many requests to speak over the past couple of years about both Nishioka's work and traditional Japanese sustainability, to share with both Japanese audiences and overseas groups what I have seen and learned. This has been extremely gratifying.

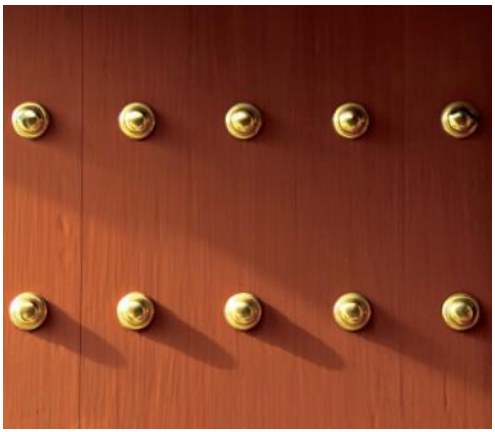

Figure 8 A close-up of one of the doors of the Great Lecture Hall, with its gilt-bronze nailhead covers. The smoothly rippled surface left by the yariganna (spear plane) can be clearly seen.

I was happy when Tuttle asked me to prepare a new edition of The Genius of Japanese Carpentry, and also a bit concerned, because book production technology has progressed

extremely rapidly during the interim between the first edition and this one. The most significant change is that we have been able to include more photos than before, and more in color. This also has posed a bit of a challenge, since so many of the original photos were shot in black and white, and designing attractive layouts that include both color and black and white is a bit tricky. But I think the book's designers have proven themselves up to the challenge. I have also taken the opportunity to include some new material, particularly photos of work that was completed at Yakushiji after the first edition was written in 1989. And I have added a number of pages inspired by the teachings for carpenters that Master Nishioka inherited from his forebears and which he had described beautifully in writing before his death. In summary, almost all of the original material remains, a handful of photos have been exchanged for better or more recent ones, and there is a bit more of Nishioka himself here than there was in 1989.

Thinking back to who I was and what I was interested in when I first came to Japan almost three decades ago, and what I have spent my time immersed in since then, about both the results I have managed to realize and the opportunities I may have let slip by, I am struck by how little of it I could have foreseen at the time. I am glad it all happened, and I still feel my debt to Tsunekazu Nishioka deeply.

The oral teachings (kuden) of the master carpenters of Horyuji

Nishioka inherited a wealth of oral and written guidelines for the master temple carpenters of Hōryūji temple that have been passed down from generation to generation, and which he received directly from his grandfather. Quite a few of these

guidelines deal with technical aspects, such as the use of tools and the preparation of materials, but a number of the most significant are instructions dealing with the mental and emotional aspects of the work, such as leadership, compassion, and spiritual preparation. In these sections, we will discuss several that Nishioka considered particularly important.

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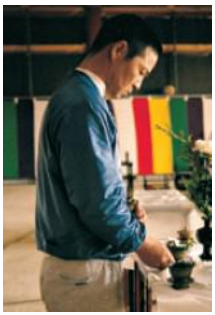
“A person who doesn’t appreciate Shintō and Buddhist thought should be quiet about the design of religious compounds.”

According to Nishioka, because the design of religious buildings is based on spiritual concepts, unless a carpenter understands and respects those ideas and practices, he really cannot play an important role in their design and construction. This is true, he said, for any kind of work. Whatever a person is involved in making, it is essential to have a good grasp of its underlying meaning and purpose. Because of this,

“understanding” is the first essential ability a temple carpenter must have.



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“When designing a temple complex, find a site that suits the requirements of the ‘Shishin’ (Four Gods).”

“The ‘Four Gods’ are a Chinese concept concerning
deities related to the four compass directions:
Seiryu (Azure Dragon):
Presides over spring and the east.
Suzaku (Vermilion Bird):
Presides over summer and the south.
Byakko (White Tiger):
Presides over autumn and the west.
Genbu (Black Tortoise):
Presides over winter and the north.”

Nishioka described these deities as metaphors for natural forces associated with aspects of topography and the environment, geomantic principles which have practical implications. The Azure Dragon (Seiryu) is a pun that also means “clear stream” in Japanese. According to Nishioka’s

tradition, a good temple site will have a stream or river to the east, which is important primarily as a water supply that should make use of spring floods. The Vermilion Bird (sometimes translated as “phoenix”) refers to a lake or marsh to the south, on ground slightly lower than the temple complex, which is important for adequate drainage during the rainy season. The White Tiger symbolizes a wide road to the west of the temple, important for transporting materials easily when the temple is under construction and for preserving its prominence and status in future generations. The Black Tortoise, usually depicted as a tortoise and snake together, is a mountain shaped like a tortoise’s shell. Unless there is one to the north of the temple complex, the complex will be too exposed to the northern winds of winter.

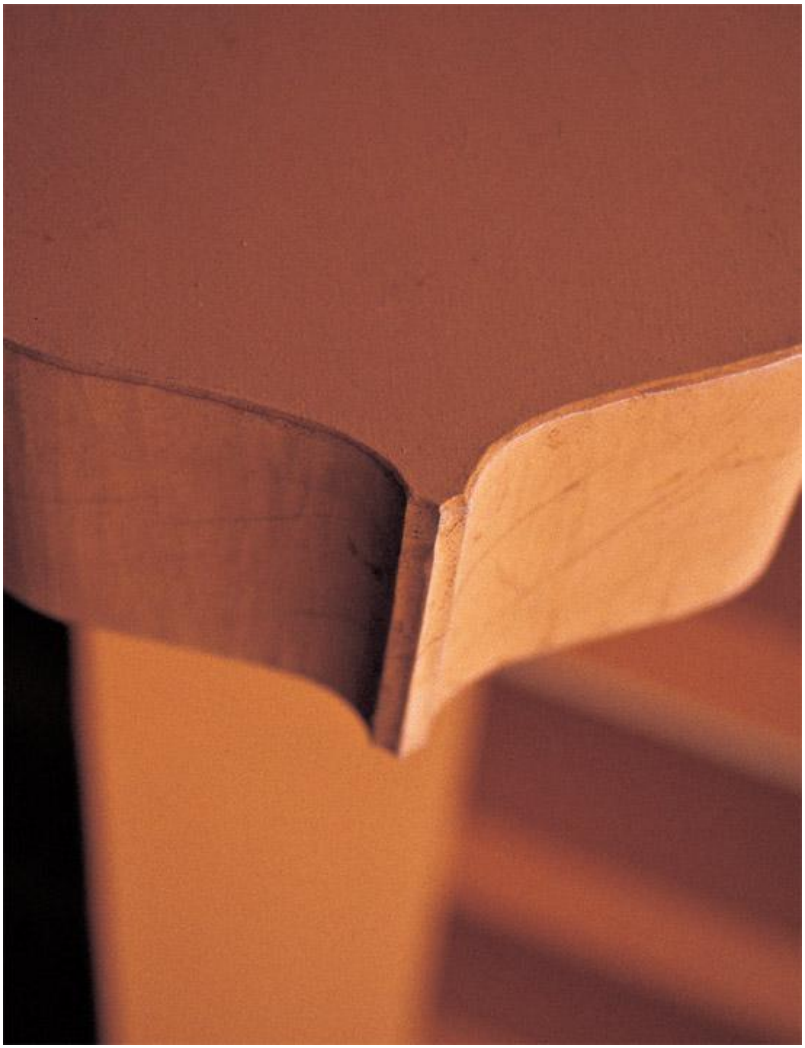

Figure 9 Detail showing the clean and careful chisel work of the decorative pendant (gegyo). (See also Fig. 201 and photo page 73.)

Introduction to the First Edition

In the very broadest terms, in this book I have attempted to provide a survey of the unique restoration work and new construction presently in progress at the 1,300-year-old Yakushiji temple in Nara, Japan. More specifically, my aim has been to chronicle the building of one new temple within that compound, the Picture Hall in the Sanzō-in subcompound. The entire project is being carried out under the direction of a remarkable eighty-year-old carpenter, Tsunekazu Nishioka. Part of a line of craftsmen extending back over a thousand years, Nishioka is one of the few master temple carpenters, or miya-daiku, remaining in Japan. Such miya-daiku specialize in the construction and repair of Shintō shrines and Buddhist temples, and in the case of Nishioka his attitude toward his work is deeply influenced by the philosophy of Buddhism. Without him, very likely this book would never have been undertaken, let alone the Yakushiji project itself.

The parameters of the book are shaped primarily by my personal observations of the Yakushiji reconstruction project over a three-year period from 1985 to the present, though my interest in temple architecture dates from the late 1970s when I was an undergraduate art student. This is not a history book, although history plays an important role; neither is it a "how-to" book, though I would be pleased if designers or carpenters found some inspiration in its descriptions and illustrations. It is an on the scenes account of a complex process of construction, reworked and digested for a lay audience. Since many readers, particularly those with a background in Western crafts or architecture, may be

unfamiliar with the design, development, and atmosphere of Japanese temples, I will begin with a few general comments.

Temples of Buddhism

A Buddhist temple can be considered a physical model of the abstract philosophy of Buddhism. It is an architectural composition intended to provide a physical and sensual experience conducive to the mental and spiritual experience of the Buddhist faith, with virtually every element designed for both sensual and symbolic value. Admittedly, this relationship is by no means unique to Buddhist temples. Cathedrals, mosques, synagogues, Hindu temples, Stonehenge, Mayan pyramids, and the kivas of the American Southwest, for instance, are in each case both extraordinary physical experiences as well as models of a particular cosmology. The uniqueness of Buddhist temples, however, is a function of the way in which the development and spread of Buddhism throughout Asia engendered cumulative architectural change. Thus, one can find Buddhist temples that share the same underlying conceptual basis but are nonetheless distinctly Indian, Thai, Chinese, Korean, or Japanese in form and detail.

What then, one may ask, is a Japanese temple? Let me first state that it should be distinguished from a shrine, that is, a Shintō religious structure, although the two may often look quite similar. Second, Japanese temples are almost invariably made of wood, in contrast to Indian and certain Chinese varieties; and they usually, but not always, consist of more than one building, with major structures being considerably larger than the average house. They can be found in the middle of fields and in the mountains; on islands or hemmed

in by skyscrapers; pristine or in ruins; gaudy or severe; deserted or thronged with tourists; and, perhaps lastly, contemporary in appearance or more or less ancient in form. And yet, despite this variety, some might agree with a casual acquaintance of mine who remarked, as our train passed through the outskirts of Nara, "You know, the thing about these temples is that they all look alike."

Temples may look alike to some degree, but only to the extent that operas or sailboats or plates of pasta look alike. If one is looking for general similarities, they can be found in abundance. If one is alert to differences, there is an unfathomable richness of variety and refinement. It entirely depends on the eye of the observer.

Buddhist architecture came into being as a towerlike tomb in India called a stupa, which was built to enshrine the cremated remains of the historical Buddha, Gautama Shakyamuni, who is said to have lived in the sixth century BC. It set an important precedent. While the objects of worship were actually the relics hidden deep within, the tower itself became the visible object of devotion, a representation of the Buddha. Its structural configuration and decorations were designed to illustrate certain aspects of Buddhist belief, such as "upward development," "the earth," "the elements," "cycles of being," and others. Buddhist sculpture appeared shortly thereafter, strongly influenced by the arrival of Alexander the Great's armies in the Gandara region (now in Pakistan) in the fourth century v. Craftsmen traveling with these armies introduced Hellenistic styles of figurative sculpture, particularly the standing pose, which seems to have been modified slightly and adopted in Buddhist images. The recorded teachings of the Buddha, known as sutras, were collected and copied in

Sanskrit and Pali, the primary languages of the region, along with monastic rules and commentary. Thus, by about 100 BC, three primary means of dissemination of the Buddhist faith had arisen: architecture, fine art, and writing.

Buddhism spread to China in AD 64 by way of central Asia, with important schools being established in Tibet as a sort of midway point. Chinese civilization had already experienced centuries of a high level of development and boasted a sophisticated imperial and bureaucratic architecture. These existing forms were adapted for Buddhist use, usually through the inclusion of Buddhist images and decorative details derived from Indian prototypes. The "stacked umbrellas" which crowned the stupa evolved into the pagoda, a wooden or masonry tower with several roofs, and temple layouts were gradually standardized. Distinctively Chinese sculpture and painting appeared about the same time.

The Korean peninsula in the early centuries AD was divided into several rival kingdoms, all of which maintained varying degrees of contact with and dependence upon the central Chinese authority. One such kingdom, called Koguryo, accepted Buddhism in AD 372, followed by the Paekche kingdom in 384 and Silla in 528. Paekche introduced Buddhism to Japan in 538 (some scholars say 552), when it presented the Japanese ruler with a gilt-bronze statue and a scroll of sutras. The first Korean Buddhist temple carpenter crossed the strait to Japan in AD 577, thereby inaugurating the tradition of Japanese Buddhist architecture.

When thinking about the history and culture of Japan, one must always bear in mind its isolation from the Asian mainland and the unusual cultural relationships that this

separation generated, particularly with respect to the Korean peninsula. The strait which divides Japan from the continent often proved a great barrier to migration and the dissemination of ideas, with the result that the technological development occurred at a different pace compared to the rest of Asia or to the Mediterranean basin. Nevertheless, several large waves of migration into Japan during the preliterate period resulted in striking technological leaps.

The inhabitants of Japan during the Paleolithic (Jomon) and Neolithic (Yayoi) periods built homes and other structures out of wood. Jomon people (1000–300 BC) knew only stone tools, did not use what we would consider wooden joints, and did not have much in the way of specialized architecture, although remains of some very large structures have been unearthed. The Yayoi period (300 BC–ad 300) is extremely interesting in that it began with stone technology but witnessed the rapid transition to metal tools introduced from Korea, bronze and iron appearing almost simultaneously. Rice agriculture was also introduced at the beginning of this period, and raised granaries and other building types which required better woodworking tools were built. Nevertheless, stone cutting tools continued to be used in some contexts in Japan until about AD 300.

Unified government, Shintō shrines, and monumental earthwork tombs arose around AD 350, during what was still a preliterate phase that lasted until the arrival of the scroll and statue from Korea in 538. This evolution, of course, did not occur evenly throughout the archipelago, but by the end of the Asuka period in 661 it is estimated that there were some fifty Buddhist sanctuaries in Japan, scattered from northern

Kyushu to the central part of the island of Honshu (the western part of present-day Aichi prefecture).

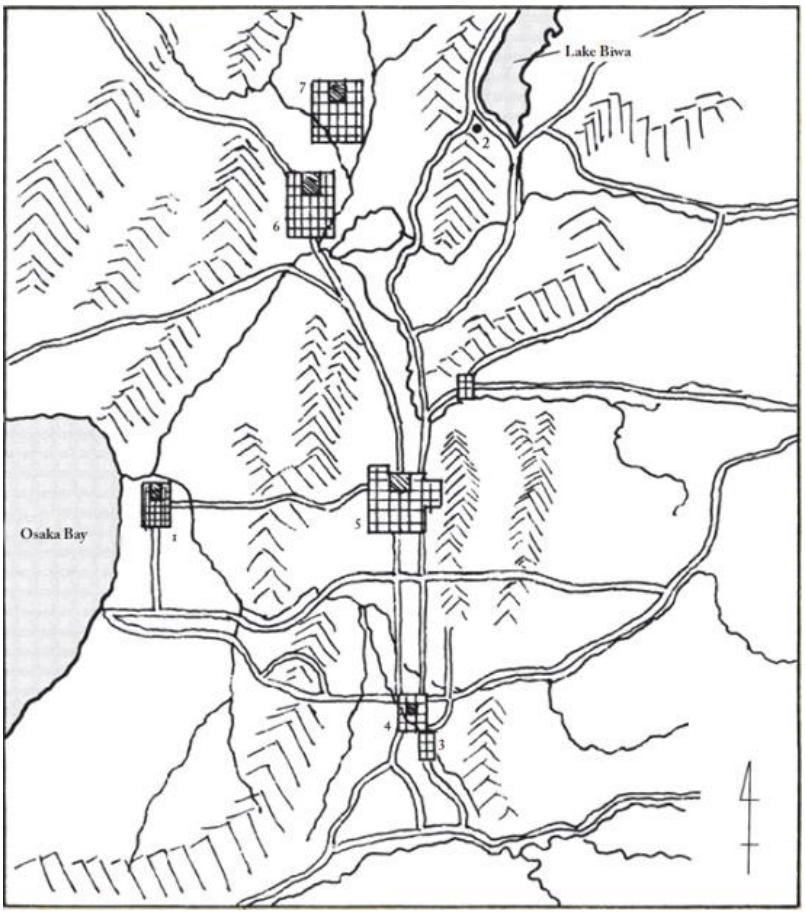

Figure 10 Map of the early Japanese capitals:
1. Naniwa (645–67); 2.Ltsu (667–72);
3. Kiyomihara (672–94); 4. Fujiwara (694–710);
5. Heijō [Nara] (710–84); 6). Nagaoka (784–94);
7. Heian [Kyoto] (794–1868).

The continental architecture introduced along with Buddhism possessed several features that were radically new. The Japanese had until then sunk pillars directly into the ground; Chinese and Korean builders set them atop foundation stones and stone-faced podia. The connections between columns, beams, and rafters, which the Japanese had kept as simple as possible—on smaller structures often merely bound with rope—were replaced by intricate structural bracketing systems. Eaves and other major structural lines, which were usually straight in early Japanese shrines, now took on the typically "Oriental" upswept curve. Roofing tiles made their first appearance, although indigenous thatch and shingle remained in frequent use. And lastly, whereas the Japanese had used only bare wood surfaces, the Koreans and Chinese demonstrated the use of floridly painted wooden members and decorative gilt fittings. We can only imagine how dazzling the new temples must have looked to an average Japanese villager of this period, entering a new Chinese-style capital for the first time and being confronted with the spectacle of polychrome spires and vast tile-covered roofs extending in an uninterrupted vista to the horizon. The experience must have been awe-inducing, an unsettling but intriguing "future shock."

The building types introduced by the Korean carpenters at the beginning of the ancient period were of two major types: the pagoda, or tower (still housing in its base the nominal relics of the Buddha), and the so-called "golden hall" (housing the temple's most important paintings and statues of the Buddha). These buildings were surrounded by a roofed corridor or cloister with a prominent gate, and included several other buildings. As mentioned above, the earliest temples were all built in the area of present-day Nara, in or near one of the

capital cities (Fig. 10). These earliest temples, which include Asuka-dera and Shitennōji, followed the strict symmetrical layout of their Chinese and Korean prototypes. Although varying in detail, they were all composed to emphasize the soaring pagoda, a means of indicating that the relics of the Buddha in its base were considered more important than his statue housed in the golden hall.

Even at this early period, however, the Japanese seemed to favor asymmetrical compositions, and before long temples were built to suit this preference. Among the most notable is Hōryūji, established in AD 607 by Prince Shōtoku, the figure credited with unifying the Japanese government under one imperial house, partly by encouraging the universal adoption of Buddhism. The present Hōryūji, whose central precinct contains the oldest wooden buildings in the world, dates from AD 670, when it was rebuilt after a fire. Despite the widespread approval with which the pleasingly dynamic design of Hōryūji was met, Japan did not completely abandon the symmetrical principle of continental temple layout.

Yakushiji temple, the subject of this book, was erected in 718 (Figs. 11, 23, 24). It marked a stunning recurrence of the symmetrical composition of the Chinese prototypes, including two 30-meter-high pagodas that flanked and set off the Golden Hall, an arrangement which may reflect an increase in image worship versus reverence for relics. Only the West Pagoda contained relics, so the East Pagoda seems to have been intended primarily as an aesthetic element. Yakushiji was destroyed by fire during the late middle ages, but the East Pagoda survives to this day intact. In large part, it has served as the basis for the complete restoration and reconstruction of Yakushiji currently in progress.

Figure 11 Yakushiji main compound as seen from the southwest in 1987. The reconstructed West Pagoda is in the center, the 1,300-year-old East Pagoda to the right, and the reconstructed Golden Hall to the left.

From these beginnings, Buddhist architecture in Japan proliferated in a complex evolutionary process, often difficult even for specialists to unravel. New sects, new building sites, shifting patronage, and technological development (as well as occasional regression) have all contributed to the diversity of building types and details, of scale and experience. And yet, in terms of religious experience, certain factors seem to have remained fairly constant.

Regardless of the specific design, a Japanese Buddhist temple essentially provides a setting for contemplation and prayer, usually in the presence of religious paintings or sculpture. “Good deeds” in the form of offerings of money, incense, and food are performed according to prescribed rituals, and there is usually an area set aside for rest and refreshment. Passage through a temple is a kind of ritual in itself, a process of crossing through successive gates, penetrating deeper and

deeper into the temple sanctuary. Temple buildings are almost always set apart on raised platforms which require the ascent of several steps before reaching the doorway. Doors are generally massive with a large sill which must be deliberately stepped over; the size of the doors is partly due to the absence of windows to admit light (although this depends on the specific building). A large sand-filled brazier is usually set before the doorway so that visitors may burn a stick of incense before entering, a form of purification. The difference in light levels between inside and outside, one of the most striking features of most temples, is intentional. Due to the broad eaves and relatively small openings for lighting, almost all the light that penetrates the interior is what has been reflected upward from the ground. The effect of this dim light, magnified in effect as it strikes the delicate gilt statuary and fittings, together with the incense-laden air, is moving and mysterious (Fig. 12). When one realizes that this type of atmosphere has survived essentially unchanged from antiquity, the sense of continuity with the past can be profound. This psychological effect arises from an environment that stimulates all of our senses: the coolness of the interior, its dimness and muffled acoustics, the mingled aromas of candle wax and incense, and an almost palpable memory of the tastes of tea, rice cakes, and small temple sweets. That such surroundings are highly evocative of the hope and despair of countless generations and their striving for purity is not incidental. It represents, rather, millennia of refinement and evolution in design, wherein the most profound aspects have been retained and the rest modified slowly over time. It was probably this overall consistency that caused the fellow I encountered on the train in Nara to remark, “They all look the same.”

Figure 12 The quiet harmony of black lacquer, gilt, and fresh flowers in the dimly lit interior of the Yakushiji Golden Hall.

An Unlikely Apprentice

It is not often that a new temple building—to say nothing of a large complex—is built in the "old way" in Japan today. I feel truly fortunate to have had the opportunity to observe such an undertaking close at hand, something which would have been impossible without the permission of master carpenter Nishioka. At the outset, there was no book planned. I approached Nishioka—after a long, labyrinthine process of leads, dead ends, and introductions to people who might obtain introductions to others who might be able to get me an appointment with the master himself—as an awkward American youth with an interest in Japanese carpentry, clutching a handful of slides of my own timber framing work in New England. On learning of my hope to return later to Japan to study more about its wooden architecture, Nishioka offered to take me on as an apprentice. I was shocked, to put it mildly; more shocked, in fact, than flattered, for I knew even then that an apprenticeship, if it was to be worthwhile,

should last at least seven years. I doubted I could afford to spend so long in Nara. Besides, absolute obedience is not one of my stronger points.

Despite my refusal of his generous offer, Nishioka helped me receive a grant from the Japanese Ministry of Education for study and research as a graduate student in the architecture department of the University of Tokyo. In addition, he gave me carte blanche to roam around the workshops and construction sites and take photographs. Most significantly, he frequently took time out to answer my questions (which, I fear, served primarily to reveal the true dimensions of my ignorance). I say "answer" my questions, which is perhaps true of the simpler ones about names, dates, terms, and so on, but for the more probing questions—those concerning the "whys" of his motivation and the "hows" of his work—while I usually received something by way of reply, I never got "answers." His responses were almost invariably in the form of subtle hints that I was not being observant enough.

Learning to Observe

In order to know what should be built, Nishioka seemed to say, it was first necessary to observe what already existed. What was worth preserving? What sense, what atmosphere, should be duplicated in a new construction? It is possible for a code or formula to be followed to the letter and yet result in a work devoid of life, inert. This is the crucible of tradition: not formulae, but innate sense; not "design," but patterns of action and use. Only these can lead to the preservation of those fragile constructs we call "culture."

In this light, then, what is a temple? Going beyond the religious symbolism that the form and layout represent, in a diagrammatic sense a temple must above all be a familiar and evocative part of an ancient continuum that includes the labor and intentions of those who built it. This is what Nishioka and those who share his goals are attempting: to extend that continuum another generation through their sincerest efforts, guided by a sure awareness of what has gone before.

Watching this work for the first time is mystifying and perplexing: every action contains an implicit connection with other, unseen actions, a fact which is reflected in the actual configuration of the components. Some have slots, others tenons, and yet others indescribable curves, baffling even to an analytical mind. In fact, every part, if not itself curved, is part of some greater curve, and fits neatly into, onto, or around one, if not several other parts. And yet the carpenter's sole guide, as he negotiates his way through his assigned tasks, is the information provided him in the form of templates and shop drawings. Only one person possesses all the information about the temple being built, including future stages of the work, and that person is the master temple builder, Tsunekazu Nishioka. The carpenters working under him must concentrate solely on the job at hand, following instructions. Observation is vital, but wagging one's tongue with "whys" and "whens" is considered not only bad form but a waste of time as well.

When this particular building, the Yakushiji Sanzō-in Picture Hall, was finally erected, mostly within a six-month period, most of my questions were graphically and demonstrably answered. The parts literally fell into place. A building, especially a wooden one, is primarily a skeletal framework

that illustrates structural forces, which is generated by desired patterns of human use and occupation. The placement of columns, for instance, depends upon where people need shelter for standing, sitting, or moving, and the size of the parts depends primarily upon how large the whole is desired to be: big buildings almost always require big parts. In a temple, size, or scale, may be considered a "symbolic function," as can many details of its configuration. The nature of the materials must also be taken into account: their properties and limitations, their grain and cellular structure. These factors, along with the physical and mental abilities of the builders, as well as cultural influence, dictate how the components will be joined to one another. The physical form of a temple like Yakushiji is the result of the interaction of a myriad patterns, some physical, some abstract, but all connected, a vast, emotionally laden webwork of decisions.

The fabrication of the parts of the temple is often enigmatic, and raises dozens of questions that can only be answered by closely observing the construction process itself. But this brings its own frustrations, for many components are combined into beautiful new structures only to be obscured by successive additions, and often totally concealed in the end. The wood joints, for instance, are very beautiful in their naked, unassembled state, but once "activated" by being put together, they often become invisible, leaving only a subtle line showing on the surface which fails to suggest the topological complexity of what is hidden inside. The roof structure, also remarkable in its layers and interconnections, is largely concealed, in deference to an aesthetic tradition which calls for an illusion of effortless structural support. And yet, it is all very satisfying in the end: intricate conformations

ultimately fulfill themselves, pieces slip into allotted slots, craftsmen accomplish their appointed tasks, and move on.

CHAPTER 1

WOODWORKING IN JAPAN

In most discussions of traditional Japanese architecture, one of the first questions raised is why wood has been the primary building material, contrasting so sharply with the Western tradition, whose ancient monuments were almost always of stone and brick, and even with Chinese and Korean architecture, where masonry figures almost as prominently as wood. The Japanese invariably attribute their universal use of wood to the archipelago's natural endowments. Wood and bamboo have existed in abundance from primeval times, while accessible and appropriate building stone was negligible. Seismic disturbances are also frequent. Hence, the reasoning follows, practical limitations dictated an exclusively wooden architecture.

We need not, perhaps, accept this explanation at face value. After all, Japan is a mountainous country with an abundance of rock, and a glance at the stone walks of medieval gardens, or at the meticulous masonry of castle retaining walls, reveals a highly refined aesthetic sensitivity and technical sophistication. Why were these techniques not utilized in the construction of entire buildings?

Figure 13 Master carpenter at work, from Shokunin zukushi-e, ca. 1640.

It may be that the choice of materials was influenced, much more than is generally recognized, by the manner in which mainland technology was received in Japan. Although a handful of large indigenous wooden shrine buildings preceded the introduction of Buddhist temple construction in the sixth century, the new woodworking tools and techniques represented a great leap forward in technological complexity, sophistication, versatility, and durability. Building upon woodworking methods whose rudiments were already familiar to the Japanese—we know from archaeological finds that pre-Buddhist Japanese building was chiefly in wood with the notable exception of monumental tombs that exhibit a precise fitting of huge stones—the Japanese were able to leapfrog several centuries of technological evolution. An important point to keep in mind, however, is that this technology was quickly canonized as emblematic of the new political regime, which sponsored its development and the education of new generations of craftsmen. While there must have been ample opportunity to acquire advanced masonry techniques as well as wood, both during this early stage of Buddhist architecture and in later centuries, the bureaucratic and educational system may have resisted such a step as a costly extravagance or as a challenge to the status quo. It may be that with no clearly perceived need for a parallel stoneworking tradition, the material was relegated as a matter of course to secondary uses in podia, foundations, decorative lanterns, miniature pagodas, walkways, and, much later, castle walls. Another factor may have been the susceptibility of masonry to earthquake damage, though this would seem to be offset by its increased resistance to fire.

On the other hand, an element of consideration for the supernatural possibly influenced these choices. Part of the

value system symbolized by Shintō beliefs stresses love of and respect for wood as a living organism. A form of animism, Shintō ascribes consciousness and personality to natural forces such as wind and rain, sun and moon, geological formations, and non-human living things. Certain mountains are held sacred, as are parts of forests and even particular trees. The presence and will of these deities, or kami, pervaded everything. Without the permission and assistance of the gods, rice will not grow, women will not conceive, and a building will not stand.

These beliefs are celebrated to this day in the form of Shintō ceremonies for planting, marriage, and construction, to name a few, and although a diminishing number of people observe the old rituals, natural phenomena are still accorded a measure of respect. The almost religious reverence for wood is, fortunately for us, among the many traditions that have stood the test of time. A tree, like other natural phenomena, is believed to possess a spirit, and a carpenter, when he cuts down a tree, incurs a moral debt. One of the themes that runs throughout Japanese culture is the belief that nature exacts from man a price for coexistence. A carpenter must put a tree to uses that assure its continued existence, preferably as a thing of beauty to be treasured for centuries. There is a prayer that Nishioka would recite before laying a saw to a standing tree. It goes in part, “I vow to commit no act that will extinguish the life of this tree.” Only by maintaining this pledge does the carpenter repay his debt to nature.

Figure 14 Carpenters shown at work in a picture scroll dated 1805. Tokyo National Museum.

The types of trees that provided the lumber for the ancient temples of Nara and Kyoto continue to preside over the most highly respected traditions of woodworking in Japan. Perhaps the king of them all is the hinoki, a species of cypress. It is not only strong and resistant to decay but is easily workable, and has a fine grain, delicate color, and pleasant aroma. Japan's once-extensive hinoki forests have largely been cut down, the toll being especially heavy during the mid-twentieth century war effort. Today, it is among the most costly of woods. In fact, it was already becoming scarce centuries ago, forcing carpenters to use less desirable species. Keyaki, or zelkova, is much harder and more elastic as well as fairly durable. Because of its striking grain and color, it has traditionally been one of the preferred woods for cabinetmaking, but even though it is less easily workable and less durable than hinoki, carpenters have been using it for major construction for centuries. Similarly, akamatsu, sometimes called mematsu (female pine), is a red pine that is less desirable for carpenters than hinoki, but which saw

increasing use as hinoki became less easily available. The trunks of this timber, though often twisted, can be used skillfully in roof beams thanks to special techniques that have been developed for layout and joinery. Like most pine, its high resin content acts as a preservative, making it suitable for door sills and the like.

Sugi, a variety of cedar, is soft, durable, decay resistant, and straight-grained. Employed in both structural and decorative elements, its reddish brown color appears to great advantage in sliding door panels and cabinetry. Tsuga, a variety of yellowish brown spruce, is straight, flexible, and dense-grained. It has become the most common building material for all types of wooden construction, which today means primarily houses (although imported Douglas fir may displace it from time to time).

Other woods for more specialized uses include kashi (Japanese oak). Relatively scarce, it is employed for cabinets and household implements. Momiji (one type of Japanese maple) is also used for decoration. Kiri (paulownia) is extremely attractive and strong, but unfortunately rare. Although sometimes used in building, it is more commonly found in cabinetry and is the preferred wood for the small boxes in which precious scrolls and pottery are stored. Kuwa (mulberry) is hard and dark red, and is found in door pulls, carvings, and the like. Kuromatsu (black pine) and asunaro (cypress) are inferior woods of occasional use. Sakura, the famed flowering cherry of Japan, is planted for its blossoms only; its fruit is inedible and the wood rarely used.

Japanese carpenters, or daiku, are considered members of a class of worker known as shokunin. Usually translated as

"craftsman" or "artisan," the word shokunin has a strong ethical and spiritual nuance in Japanese. The use of the term, like that of daiku, has evolved over the centuries, but the essential values the term implies persist. The shokunin, in addition to repaying a debt to nature incurred by his exploitation of the earth's resources, must fulfill his obligation to society, primarily by doing whatever is required quickly, skillfully, and without waste. This ethical code and social consciousness is cultivated from the beginning of apprenticeship, which before the days of compulsory secondary education started as early as age nine or ten. When a carpenter does a poor job, for instance, it reflects both on the client and on the master; in most cases, he is not allowed to redo the work, for that would entail waste. Everyone must live with the result. According to the craftsman's code, this rule is applied to every task in life, even the menial and seemingly insignificant. The carpenter trained according to this tradition will not scoffat the most rudimentary task, says Nishioka, but will do any job that calls for woodworking—even making wooden clogs—with care and precision.

One traditional ideal, then, has been the carpenter who can perform any stage of the woodworking process, from felling trees to finishing surfaces, but in actuality there were and are specialities. There are lumberjacks who fell the trees but who are usually concerned only with the main trunk, the direction of fall, and so on. After that, a trimmer takes over, removing branches and stripping the bark. Another worker prepares logs for transportation. Finally, there is the sawyer, who transforms logs into squared lumber.

Next come the builders, beginning with the carpenters, divided over the centuries into several categories usually represented by local guilds. The "house carpenter," highly skilled in comparison to his present-day American or European counterpart, is known for his knowledge of wood and mastery of the complicated joints still in use. The master house carpenter designs the house itself (according to traditional formulae and rules of thumb) and supervises the fabrication of the components, the erection of the frame, the finishing of the interior, and so on to completion. The actual work of assembling the frame is sometimes carried out by a separate group of craftsmen, the "erectors," who carry out a variety of tasks, including the erection of the scaffolding.

Teahouse carpenters, who work on a reduced scale, create small, finely crafted buildings for the performance of the tea ceremony, usually formulating the design in conjunction with a tea school master. Tea ceremony rules call for subtle, unobtrusive design and an extremely sensitive handling of proportion and detail, as well as studied simplicity. Teahouse carpenters enjoy great prestige.

Temple carpenters, such as the late Nishioka, because of the scale of their work and its sacred nature, perform the most demanding type of carpentry and are regarded with a reverence bordering on awe. Their work includes the design and layout of Buddhist temples and Shintō shrines (although an individual rarely specializes in both). The construction of palaces in ancient times, incidentally, was often on a par with temple building, and castle building was equally demanding, but the carpenters were segregated into separate guilds. Temple carpenters must be well versed in Buddhist theology and ritual, and are treated as members of the clergy on certain

ceremonial occasions. At the time of the Picture Hall construction at Yakushiji, Nishioka estimated there were some fifty master temple carpenters working in Japan, though very few had the opportunity to work on major projects.

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“Don’t buy lumber for building material, buy a whole mountain.”

The characteristics of wood, its “spirit,” Nishioka was taught, emerge from the characteristics of the ground in which it grows. In order to fully grasp the idiosyncrasies of the wood that will be used, a carpenter should examine it in relation to its environment on the mountainside. Only then will he be able to predict how it will change in the future. Trees are individuals, Nishioka pointed out, but they grow in communities, and both aspects affect their “personalities.”

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“In a building, use wood in the same north–south–east–west orientation it grew in originally.”

A tree develops a kind of “harmony” with the forces that act on it while it is growing, like sunlight, wind, and rain, all of which typically reach the tree from specific directions depending upon where it is growing. Because of this, and the fact that wood will move and change in response to these same forces when it is integrated into a building, Nishioka and his forebears believed it was important to use wood in the same orientation it had when it was growing in order to make its future changes more predictable. Therefore, wood that grew on a northern slope should be used on the north side of the building, that from the southern slope on the south side, etc. Nishioka associated these principles with rules for selecting wood for specific uses depending on how high on the slope it grows as well; wood from trees growing midway up a mountain-side or in mountain passes will make the best structural timber, while wood from valleys is more appropriate for finish work.

CHAPTER 2

THE MASTER CARPENTER

The late Tsunekazu Nishioka was a gentle man. With an eventful eight plus decades of life behind him, he sat arguably at the apex of the world of Japanese carpentry. He oversaw a major reconstruction at Hōryūji, Japan's oldest Buddhist temple. He accomplished the better half of the reconstruction of Yakushiji, which is only slightly younger than its illustrious predecessor at 1,300 years of age. In the process, Nishioka was showered with virtually every major cultural prize bestowed in Japan, both public and private.

Part of his achievement was due to fate, for the position of master carpenter of a major temple or shrine is virtually hereditary, and in 1908 Nishioka was born into the family that had produced master carpenters for Hōryūji temple for five or six generations. Those bearing the Nishioka name represent only one branch of a larger family which claims as an ancestor the builder of Osaka Castle in the early seventeenth century. Hideyoshi, the lord for whom the castle was built, ordered the builder killed because of his knowledge of the castle's secrets, but Katsumoto Katagiri, a high-ranking warrior, helped him escape, whereupon he found a quieter life for himself as a carpenter at Hōryūji.

Figure 15 Tsunekazu Nishioka at his desk at the Yakushiji work site, 1986. Hanging on the wall are numerous wooden drawing templates for plotting roof curves, etc.

Nishioka's father was actually a farmer who had been adopted into the carpentry family as a precaution against starvation at the end of the nineteenth century, which were lean years for Hōryūji. But Nishioka's grandfather was the temple's master carpenter, and he permitted Nishioka to frequent the workshop from the age of three or four. After entering elementary school in 1915, Nishioka helped out with the sweeping, the fetching of tea, and such during his summer vacation. His grandfather insisted, against Nishioka's expectations and his father's wishes, that the boy be further educated at an agricultural school, which he entered in 1921. Grandfather Nishioka reasoned that the family should have at least one person capable of farming in times of shortage, and that, in addition, a carpenter should learn as much as possible about wood. As a result, Nishioka devoted four years to absorbing the latest scientific knowledge about earth, fertilizer, forestry, and husbandry.

After finishing school in 1924, Nishioka expected to begin carpentry work immediately, but was told to first spend one year growing rice. Only then, under his grandfather's supervision, was he allowed to handle tools, beginning with learning how to sharpen them. At the same time, he was taught how to conduct relationships with other carpenters, and at night he listened to explanations of the carpenters' kokoroe, or rules of thumb. These oral teachings, as transmitted by his grandfather, formed the core of Nishioka's values and ethic.

Nishioka worked as an apprentice for about a decade, with an interruption for military service beginning in 1929. His early projects included minor repairs on various buildings at Hōryūji, the complete dismantling and restoration of other temples in the Nara area, construction of a new Shintō shrine,

and the erection of a gate for a new palace for an imperial prince. In 1931, he made a detailed 1/10-scale study model of the Hōryūji five-story pagoda (now in the collection of the Tokyo National Museum). On some smaller projects, he acted as master carpenter; at other times, he was assistant master. In 1934, he assumed the responsibilities of master carpenter for major dismantling and reconstruction work at Hōryūji, a maintenance operation that is usually carried out every 200 years. This project, called the Hōryūji Shōwa-Era Great Reconstruction, was Nishioka's major formative experience as a master temple carpenter.

Figure 16 In the last decades of his life, Nishioka's main roles were as a planner and teacher.

During the reconstruction of Hōryūji, Nishioka discovered that the original builders had cut all of their hinoki from the hills in the Yamato area (the region surrounding Nara), and that their use of lumber—the matching of a tree's natural qualities with its ultimate placement in a building—was in keeping with the oral precepts that had been handed down to him. "Different mountains make different wood," he said, adding that "building is a matter of matching the individual personalities [of trees as well as carpenters]." Traditional carpenter's wisdom provides innumerable guidelines for exploiting the unique characteristics of different trees, utilizing twists so that they counteract each other, making sure that trees which grew on the southern face of the mountain are used in the southern side of the building, and so on. "Coming from a family of craftsmen, I had learned these principles already," he said, "but it was only when I took the buildings to pieces that I discovered that all of Hōryūji was constructed in this way. I was extremely moved. The oral tradition had been applied without exception." But the ancient standards were not always maintained, he said, and the results could be seen in repair work carried out some six centuries ago. "They simply matched good-looking trees with good-looking trees. When I rebuilt, I reverted to the old ways, perceiving the nature of individual trees, matching them north and south" ("After 51 Years, a Temple Is Restored," Washington Post, 26 December 1985).

Thus, fortune was smiling when it fell to Nishioka to oversee this rare dismantling and repair work at Hōryūji, to check up on, so to speak, the work of his predecessors of a millennium

past. “The old builders were people of art who approached their work with religious devotion,” he said. “They had no way to know how their creation would fare over the span of thirteen centuries. The privilege of finding out fell to me. I felt like a highest level doctor of anatomy” (Washington Post). In his consummately informed opinion, the buildings at Hōryūji were good for at least another 2,000 years, provided they received regular checkups and proper maintenance.

It was during the early stages of the Hōryūji restoration that he fully realized the benefit of his agricultural education. On one occasion he was called upon to examine the soil under the foundations of the temple’s eastern precinct, an analysis which won him the respect and recognition of his colleagues. He often maintained that his education had served him well: “These are the things a person needs to know in order to make a house.... If he is going to make a wall, he needs to know what kind of earth is good. If he is going to make tiles for a roof, the same holds true.... And, of course, if he uses wood, he should know how and why it grows like it does” (Teiji Itō, ed., Dōkyū no Shokunin, Tokyo: Heibonsha, 1985, p. 57).

“The Hōryūji five-story pagoda and the Yakushiji eastern pagoda are both constructed of wood which had been growing for 1,000 to 1,300 years.... That means, altogether, each of those trees has been standing for 2,600 years!” He gave as an example: “Hinoki is strongest 200–300 years after cutting.... This is traditional wisdom, so I was extremely pleased that recent research by Professor Jirō Kohara [a forestry specialist] confirmed it” (Dōkyū no Shokunin, p. 66). A sparkle would come into Nishioka’s eyes when he talked about hinoki (cypress), his favorite wood. “There are six species of hinoki in the world, but Japan’s is the best quality. That is why

shiraki zukuri [bare wood construction] began here. The six types are Japanese hinoki—which was called ma-ki, or 'true wood,' by the ancients—sawara, an inferior species found in Japan, tai-hi [Taiwanese cypress], and three species of North American cypress.... The cell structure of Japanese hinoki," of which the very best comes from the Yoshino region where it is favored by particularly fine soil, he said, "is very tight. It has a straight grain, nice color, and a delicate aroma. It is stable and easily planed, but it is unforgiving, so one must work it with only the best tools. If a sculptor tries hinoki just once, he will never want to touch any other wood" (Jirō Kohara, Nihonjin to Ki no Bunka, Tokyo: Asahi Shinbunsha, 1984, pp. 100–1).

Temple construction requires high-grade logs of large girth, which means of great age—ideally the 1,000 or more years that went into the columns of Hōryūji and Yakushiji. But such trees have become extremely scarce in periodically deforested Japan. As a result, Nishioka had to make several trips to Taiwan to select wood for the reconstruction of Yakushiji, begun in 1970. One of the carpenters' sayings, he related, is: "Don't buy trees; buy a mountain." Thus, the temple purchased large forested tracts in Taiwan for use in the restoration project. Taiwanese hinoki is very similar to the Japanese variety, but somewhat less elastic, a feature which at times requires structural members—particularly roof beams, which fortunately are hidden—to be made larger in section than traditional design dictates. But age is not always an assurance of quality, he observed. "I saw some 2,000-year-old hinoki growing in Taiwan, but their leaves were lighter than those of other trees only 200 years old. Dark leaves are a better sign. The branches of the trees with the paler leaves

were sagging because they were rotten inside" (Tsunekazu Nishioka, Ki ni Manabe, Tokyo: Shōgakkan, 1988, p. 200).

Although Nishioka valued the contribution his formal education made to his development, he regarded it as something which, while helpful, was not essential, especially when it came to training one's sense of perception. "Academics," he said, "can be very foolish. They take simple things and make them difficult.... Japanese society today measures people by their educational credentials, with the lamentable result that other equally valid ways of learning are being forgotten, even though they're backed by 1,300 years of experimental observation in Japan alone. And this has happened so quickly: in a mere 100 years, thirteen centuries of accumulated knowledge has been allowed to leak out of our culture, not just in architecture, but everywhere."

Because the craftsman's knowledge is based on experience, on endless repetition and refinement, and on direct imitation of a master's methods, a technique or attitude disappears with its possessor if not passed on through use. After the demise of a living tradition, one can analyze its artifacts for clues to their creation or try to reconstruct the methodology based on writings or oral traditions, but something essential is inevitably lost. During the premodern era, there was an active dialogue among Japanese carpenters and a sense of competition which resulted in constant innovation and perceptible improvement in skills for the craft as a whole, all done while struggling against a progressively diminishing quality of available wood. But at that time, wood construction represented the only technology available for building in Japan; nowadays, it is used extensively only in prefabricated houses, and in a manner which is increasingly automated. In

the face of interlocking industries which have settled upon steel and concrete as the most practical and profitable means of construction, wood has become something of a luxury. Likewise, the traditional means of training carpenters, which had long produced a steady stream of highly skilled craftsmen through a self-regulating apprenticeship system, has now been almost completely dismantled in favor of universal standardized education geared toward the production of office workers and technicians. Carpentry, even temple carpentry, is far from being a lucrative occupation, partly because the Japanese value system has come to disdain manual labor. "Young people? No, they don't want to do this kind of work anymore," observed Nishioka wryly. Most carpenters seem to agree that actual development, in the sense of positive innovation and improvement, is no longer possible in the field. "It is impossible to improve on the ancients," Nishioka insisted. "They were incomparably better. The most I can do is to keep a small fraction of their knowledge alive."

Some may be able to accept this decline, this cultural deskilling, without feeling any sense of loss. In fact, many Japanese regard it as regrettable but inevitable. Others, however, feel that it is neither inevitable nor inconsequential, but rather a case of painful and unwarranted negligence. The carpenters themselves, including the younger apprentices, carry themselves with the esprit that marks the last of a great breed. To share their life is to share their pain, which they generally keep well hidden except when drunk. One young carpenter, near the end of a long day of intoxicated celebration, turned to me with a grave countenance and pleaded, "You said it's painful to see how few of us are left. Suffer more, please. Then you might learn how we feel."

Needless to say, crafts are inseparable from the culture in which they are found; they are products of a complex set of interactions, a mirror of social relations. The vigor of any one part is a sign of the vigor of the entire organism, like the color of the leaves on a tree. For instance, Japanese carpenters are dependent upon the finely wrought tools that evolved concurrently with their craft. What happens when the makers of these tools begin to disappear as demand for their work declines? This has been occurring for decades. Carpenters cannot work without adequate supplies of wood, but such supplies are now dwindling throughout the world. Other crafts vital to temple building are suffering similar fates, among them traditional sculpture, painting, and metalworking. During their premodern heyday, these crafts formed a coherent whole, a dynamic and interdependent living system not unlike a temple itself.

The master carpenter is the crucial peg in this system. His primary task is to bring together the necessary people and act as the center. He must have extremely broad knowledge, embracing all the related crafts, and a comprehensive viewpoint that holds everything together. If this central peg is removed, the entire system collapses.

In order to maintain continuity with the past, one of the master carpenter's most vital functions is that of education: training those who work under him. In real terms, this means providing them with the best possible example and allowing them to learn through observation and experience. Rarely is anything explained fully to the apprentice; he must draw his own conclusions and develop his own instincts. The reasons behind given instructions become evident in time, and no amount of prior speculation or analysis is as effective a

learning tool as witnessing an actual process in an alert frame of mind. Some factors, such as the natural settling and movement of wooden structural members over time, can be grasped only after several years of observation, and then only if the carpenter has his original actions continually in mind. Nishioka, for his part, lived in close contact with the entire body of his work, which spanned six decades. He was continually forced to assess his successes and failures, seeing where the wood had taken unforeseen twists, where he had been hasty or distracted while working.

Figure 17 Nishioka checking his inkpot and line (sumitsubo).

Consequently, Nishioka was a strict teacher, seeking to form carpenters from the heart outward, as it were. Priority was given to instilling in the young apprentice a sense of respect and humility, not merely toward his superiors but, more importantly, toward the wood and the work. The first tasks are deceptively simple: sweeping the shop floor, fetching tea, helping to lift heavy members. Yet, even these seemingly mindless tasks have the potential to teach concentration, exactitude, and teamwork, all of which are absolutely essential for the more complicated work ahead. Once an apprentice has begun to develop the proper attitude, he is gradually introduced to tools and begins to assist the senior carpenters with their individual responsibilities. In about seven years, he will be capable of shaping a complex piece from shop drawings and templates; after fifteen years or so, he will know how to make the templates himself from the master's drawings.

A major project, such as that at Yakushiji, involved, during its busiest periods, about two dozen carpenters of widely varying ages and experience. The core of this crew was composed of seven or eight workers who had been associated with Nishioka as apprentices for a number of years. Other experienced carpenters were taken on for a year or so. At times, even senior carpenters would leave to work on other projects for a few months, or even years, returning to Nishioka's workshop when they were needed. The result was a loose network of carpenters, sometimes far-flung (but generally within the Kansai area), who formed a pool of well-trained labor. And all had been molded in some way by the philosophy that Nishioka expressed so lucidly. While most of the carpenters, and the senior assistants in particular, were wary of verbalizing their intentions, occasionally

philosophical observations did emerge. One day, a thirty-year-old assistant master, seemingly frustrated by my insistent questions about aspects of design related to wood movement, blurted out, “Only three things are important: sun, wind, and rain. If you understand these things, you can understand wood. If you understand wood, you can be a carpenter.” On another occasion, a much older carpenter, while walking to lunch, for no apparent reason pointed to a puddle left by the previous day’s rains and said, “It’s moving. It’s all moving,” a statement rendered even pithier by its brevity in Japanese.

At Yakushiji, Nishioka spent almost all of his time on design work, leaving the day-to-day training of apprentices to the senior carpenters. Nonetheless, he periodically checked on everyone’s progress, offering his criticism and encouragement. When actually supervising some aspect of the work, he had the bearing of a general in the field, barking orders and accepting no questions. Because of his well-earned status and uncanny perception, even the most senior apprentices were awed in his presence, some of them trembling at the thought of the reprimand he would deal should some barely perceptible flaw be discovered in their work.

On one occasion, a relatively new apprentice related a not so traumatic but memorable criticism he had received. “I was planing a block of wood and I hadn’t quite gotten the hang of it. For some reason, it wasn’t going smoothly. Nishioka was walking across the shop floor about 20 feet away, too far away to see what I was doing, but he called out, ‘You’re bearing down too hard on the back of the plane. I can tell by the sound.’ Sure enough, I adjusted my grip, and the problem

was solved." Another carpenter related how he was taught to distinguish the region in which a particular piece of Japanese hinoki was grown on the basis of its smell, with that of northern species being palpably sharper. On another occasion, I watched four senior carpenters standing at attention, silently accepting a stiffrebuke from the master. Their crime: someone had miscalculated a few millimeters on a hip rafter. The difference was hardly noticeable, even close up, but since the beam was designed to achieve its perfect form only after several years of sagging and shrinking, this small error would be magnified and possibly distort the whole. Fumed Nishioka, "They'll laugh at me. They'll say, 'That's not the way a hip rafter should look!' And I won't be around to defend myself."

Figure 18 Nishioka inspecting his tools.

Indeed, the most remarkable thing about Nishioka was his sense of time, time as measured in centuries and millennia (Fig. 19). His viewpoint was purely Buddhist: time is cyclical, the universe is constantly being destroyed and remade, over countless eons, throughout all of which our spirits are intact. Life is painful, especially when compared with the intervals between death and rebirth. “If a carpenter dedicates himself spiritually to the construction of a temple, and that temple lasts a thousand years, then he will have a thousand-year interval between this life and the next. Consequently, that thousand years really isn’t very long. And when you think that a tree takes a thousand years to grow large enough to use for a temple column, and that the temple may stand for a millennium or more, even a decade spent in its construction is infinitesimal.” Nishioka believed that one should take as much time as necessary. One should concentrate completely all the while, and be in good spirits, because a craftsman’s frame of mind permeated every aspect of his work, and the work would bear the imprint of its creator as long as it existed.

Admittedly, it is difficult for most of us to consider a thousand years as a brief period, or to believe we can delay our rebirth by dint of diligent work. Nishioka, however, was convinced that the ancient Japanese temples, several of which are over a thousand years old, were built in the spirit he described, and that the same spirit can be maintained today. This is what he attempted at Yakushiji.

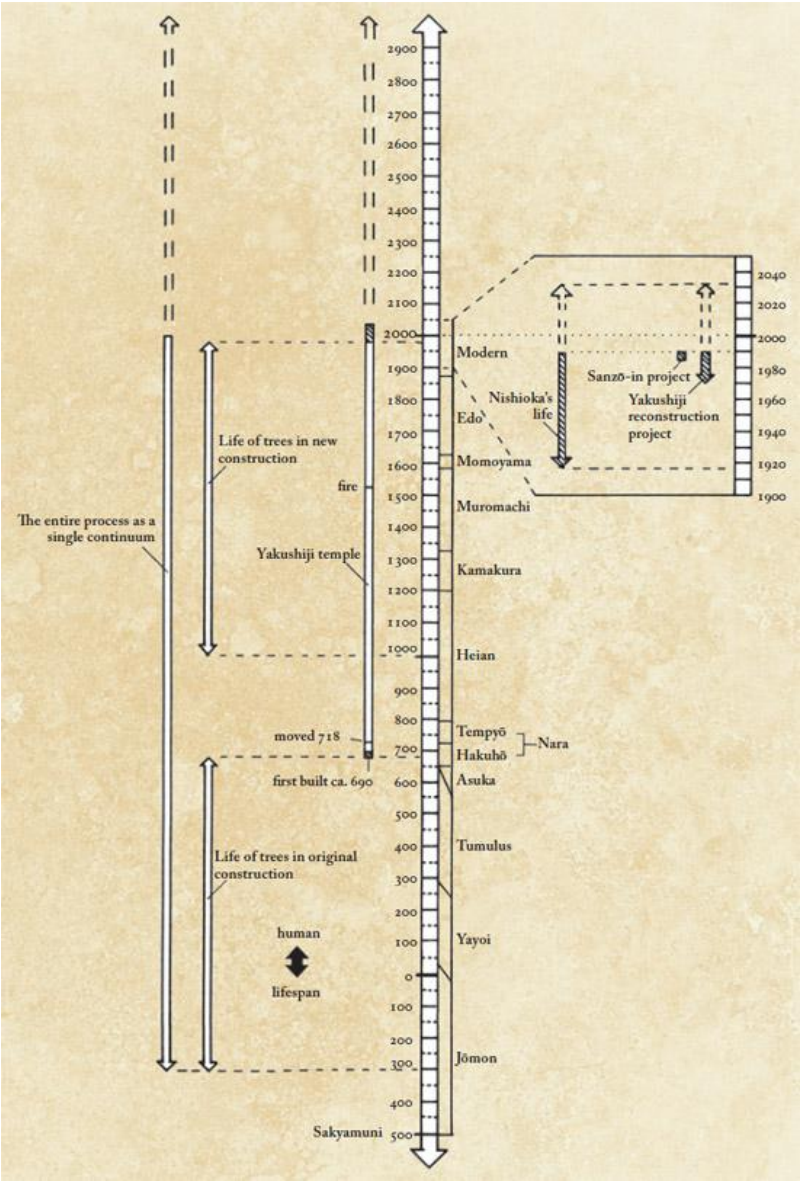


Figure 19 A temple carpenter's timetable.

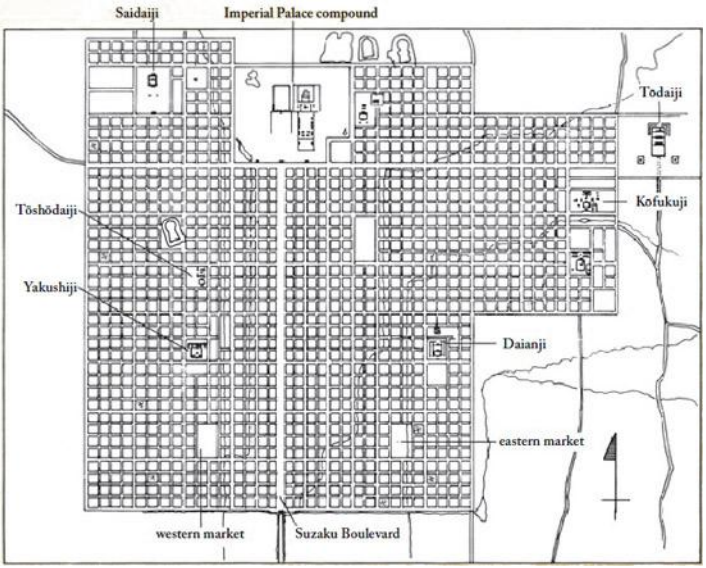
CHAPTER 3

THE YAKUSHIJI PROJECT

Yakushiji temple, one of the original seven major temples of Nara, was first planned by the emperor Temmu in AD 680, at which time the capital of Japan was a city south of present-day Nara called Fujiwara (now known as Asuka). Temmu's intention was to have the temple dedicated to Yakushi Nyorai, the Buddha of healing, as a means of aiding the recovery of the empress Jitō from a serious illness. As fate would have it, the empress survived but Temmu himself died before the temple was completed. Empress Jitō completed the construction as well as the casting of the primary bronze statuary. Yakushiji was dedicated in 697 and completed in 698.

A little over a decade later, a new capital city called Heijō was built slightly to the north of Fujiwara. This is the site of present-day Nara. Since the jointed wood construction of the day allowed for easy dismantling and transportation of buildings, many major structures, such as palace buildings and temples, were simply moved to the new capital. Yakushiji was relocated to its present site in 718, where it was afforded a large, prominent plot of land, appropriate to its status as a "first-class" temple. Following Chinese precedent, the capital was carefully zoned into blocks, which were awarded to temples, aristocrats, merchants, and others on the basis of both practicality and prestige (Fig. 21).

Figure 20 The Yakushiji West Pagoda (Saitō), whose reconstruction by Nishioka was completed in October 1980. Compare it to the original East Pagoda (Tōtō), Fig. 27.


Saidaiji
Imperial Palace compound
Tōdaiji
Kōfukuji
Tōshōdaiji
Yakushiji
Daianji
eastern market
western market
Suzaku Boulevard

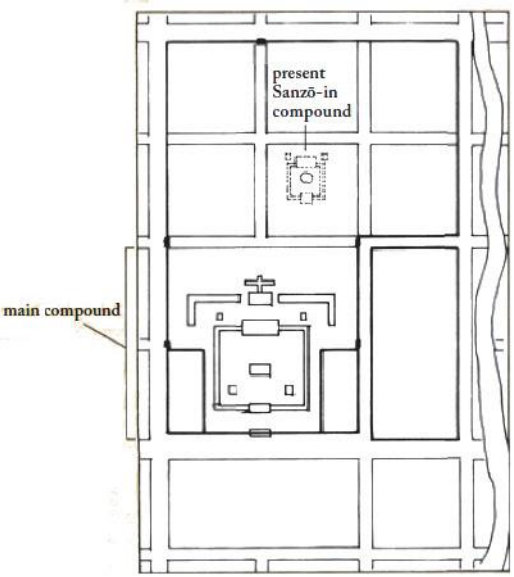

present
Sanzō-in
compound
main compound

Figure 21 Map of Heijō (Nara) in the eighth century and a detail of the Yakushiji area.

Figure 22 Side view of the Central Gate (Chumon) of the main Yakushiji complex, completed in 1984. Cloisters (Kairō) were added in 1991. (See also Figs. 23, 29.)

Yakushiji has from the outset been a temple of the Hossō sect, which was founded in China in the seventh century by Hsüantsang (Genjō Sanzō in Japanese) and was the first Buddhist sect to be brought to Japan. The original layout of the temple, which is a complex of several major buildings grouped within and around a large walled enclosure, features twin pagodas, each 34 meters high. Though in fact three stories, the pagodas are designed to appear six-storied through the addition of "false" roofs between the roofs of the actual structural floors (Figs. 20, 27). This design treatment is used in the nearby Golden Hall and other buildings as well. The Golden Hall (Fig. 28) houses the triad of bronze statues cast late in the seventh century representing Yakushi Nyorai and two attendants, Nikko Bosatsu (the Sunlight Bodhisattva) and

Gakko Bosatsu (the Moonlight Bodhisattva), all three of which are now designated National Treasures. The design of the main enclosure of Yakushiji centered on the main figure of Yakushi Nyorai, and the other structures were arranged in such a way as to emphasize its centrality (Fig. 24). In its most complete form, the main complex included the two pagodas, the Golden Hall, the Lecture Hall, a massive Southern Gate, a smaller Central Gate, and a surrounding ambulatory corridor. Among lesser edifices were a bell tower, a sutra repository, and residences, offices, and a refectory.

The capital city was moved again in 794 to present-day Kyoto, partly because the powerful Nara temples had become a political nuisance. Yakushiji did not accompany this move, but remained in Nara. In time, rival sects appeared and obtained imperial sponsorship, causing Yakushiji to decline in importance. The temple thereafter fell periodic victim to fire and natural disaster, the worst of which was the torching of the temple during the civil war of 1528. The golden statues were blackened by the flames, and every building but the East Pagoda was destroyed. A temporary Golden Hall was erected in 1600 and a new Lecture Hall in 1852, but by the mid-twentieth century the temple had deteriorated into a scarred veteran surrounded by rice paddies and overgrown with trees, with few remaining hints of its former grandeur.

Perhaps the abbots of Yakushiji had dreamed from time to time of reconstruction. But even assuming that a craftsman could be found who was capable of such a major undertaking, there would always remain the daunting problem of funds. Before the modern era, the national government had little or no interest in the architectural reconstruction of now obscure Buddhist sects, and with the onset of the modern era, what

money was available for ecclesiastical construction was poured into building and maintaining Shintō shrines as a means of legitimizing the government's claims for the emperor's divinity. Some of the newer Buddhist sects, such as Pure Land and Shingon, had grown quite wealthy on the donations from the faithful, but Yakushiji was not in such a position.

Figure 23 Aerial view of Yakushiji in 2011. The original East Pagoda is on the right, and the reconstructed West Pagoda on the left. The building with the largest roof is the Lecture Hall. The two-story building in front of it is the Golden Hall, and in front of that is the Central Gate. The Cloister (corridor) has been left open at the upper left and right corners. The Sanzō-in can be seen at the top of the image, just right of center. Compare to the plans opposite. Photo courtesy Uzumasa Films.

In the late 1960s, however, noticing what seemed to be a small resurgence in Buddhist faith since the end of the war, a

new abbot of Yakushiji, Kōin Takada, conceived a plan to raise the funds for reconstruction. He organized a movement for copying the Heart Sutra, the major scripture of the Hossō sect, whereby worshipers visiting the temple could spend an hour or two transcribing the sutra by hand as an act of devotion, leaving a donation when they departed. Takada considered it of utmost importance that funds for the temple should come not from corporate donations but from ordinary people as an act of spiritual devotion; he intended it to be an eternal movement. By the late 1980s, over 3,500,000 people had contributed in this way.

Because of Master Carpenter Nishioka's tremendous success with the Hōryūji restoration, he was the obvious first choice for director of the Yakushiji project. It was not easy for Nishioka to make the decision to move from Hōryūji to Yakushiji, but he eventually agreed. He began by making a model of the West Pagoda under the sponsorship of the Kintetsu railroad company, which was building a historical museum within the confines of a train station in Nara. Then, in 1970, Nishioka collaborated with the noted architectural scholars Hirotarō Ōta and Kiyoshi Asano on the conceptual design of the Golden Hall, and produced a preliminary model. Later that year, Nishioka traveled to Taiwan for the first time to look at hinoki, since suitable timbers were not available in Japan.

Since the statues to be housed in the Golden Hall have been designated National Treasures, stringent regulations govern their care. One of these stipulates that they be housed in a fireproof structure. Despite Nishioka's opposition, the design of the new Golden Hall therefore featured a central core of reinforced concrete, equipped with well-concealed automatic

fire shutters and sprinklers. This core is ingeniously mated to the enveloping traditional wooden structure that forms the visible edifice. The approach is quite novel, faithful to the original, and, fortunately, entirely unobtrusive. The groundbreaking ceremony was held in May 1971, that for the column raising in April 1973, and that for the raising of the ridge beam in December of the same year. The Golden Hall was completed in July 1975 and dedicated in April of the following year. It had taken a total of six years from conceptual design to dedication.

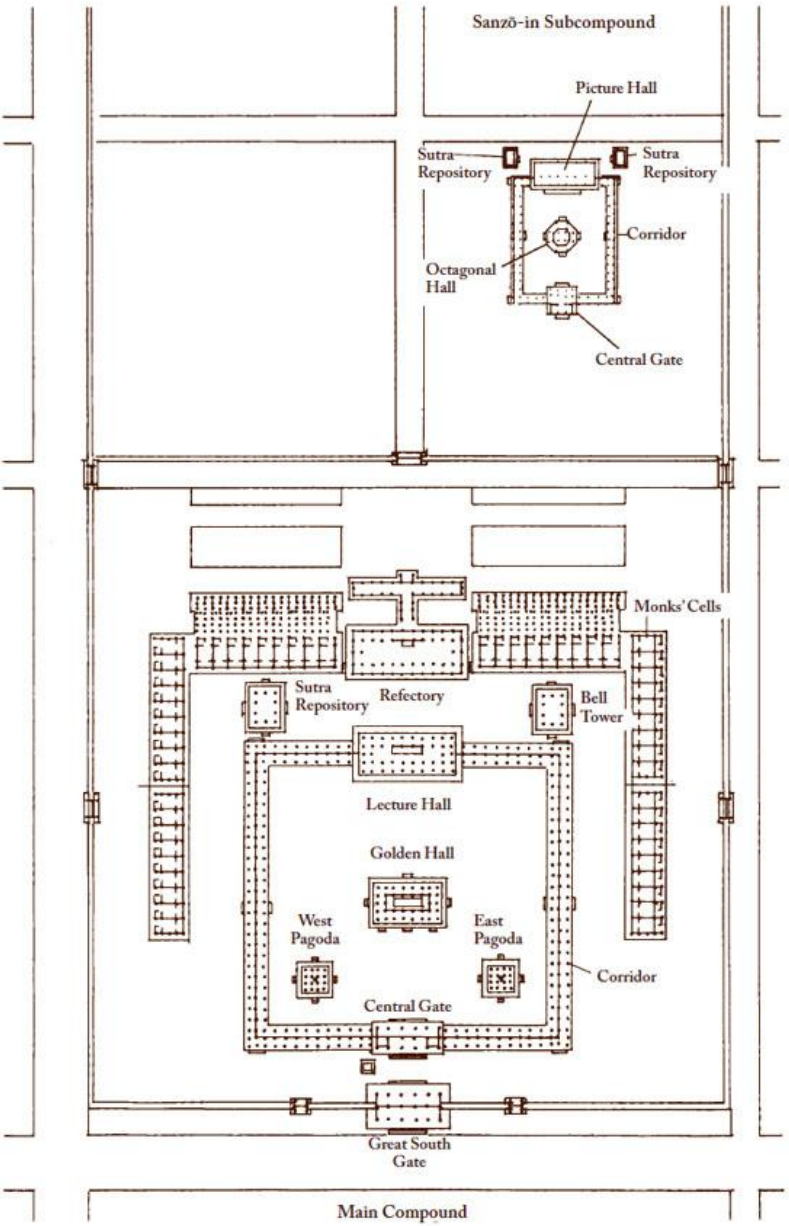

Sanzō-in Subcompound
Picture Hall
Sutra Repository
Sutra Repository
Corridor
Octagonal Hall
Central Gate
Monks' Cells
Sutra Repository
Refectory
Bell Tower
Lecture Hall
Golden Hall
West Pagoda
East Pagoda
Corridor
Central Gate
Great South Gate
Main Compound

Figure 24 Original layout of Yakushiji, with the Sanzō-in added.

Figure 25 and Figure 26 Nishioka based the design of the West Pagoda (right) on careful measurements of the 1,300-year-old East Pagoda (above). Like its predecessor, the new pagoda and all of the reconstructed buildings at Yakushiji were designed to age gracefully.

Figure 27 The East Pagoda (Totō) has survived since AD 730. Compare it with Fig. 20.

Figure 28 The Golden Hall (Kondō) houses important votive statues, and its reconstruction was completed in 1975.

Figure 29 The Central Gate and West Pagoda. At the time this photograph was taken, in 2013, the East Pagoda had been disassembled for regular repairs, and was enclosed in a temporary protective structure just visible at far right.

Figure 30 The Lecture Hall (Daikodō) was completed in 2003. It is the largest building at Yakushiji and was finished after Nishioka's death by his apprentices. (See also details, Figs. 1, 8.)

The reconstruction of the West Pagoda (Fig. 20) commenced in earnest in June of 1976 when Nishioka and his assistants began measurements of the 1,300-year-old East Pagoda (Fig. 27) to determine every detail of its construction. The foundation stones of the West Pagoda, which remained intact from the time the superstructure was destroyed in the sixteenth century, were excavated by the Nara National Research Institute of Cultural Properties. Nishioka's design of the new West Pagoda adhered as faithfully to the original as possible, although some minor changes in concealed structural members were necessary in order to compensate for the different structural characteristics of the Taiwanese hinoki.

Another consideration was the uppermost roof of the new pagoda. The roof of the older East Pagoda, which served as a model, was not the original one, but the result of repairs in the Edo period, when it was altered to suit then current preferences. For the new pagoda, it was decided to recreate the original profile. In order to do this with utmost accuracy, Nishioka calculated the ultimate shrinkage of the lumber in the entire structure and the degree of settling it would cause, keeping in mind that the vertical and non-loadbearing central pillar would not settle at all. Thus, when the central pillar was installed, it was raised on wooden wedges a few centimeters above the foundation stone so that the wedges could be withdrawn incrementally over a period of years as the surrounding structure settled around it. After several years, the wood had fully stabilized, the roof angle was correct, and there were no gaps where the central pillar emerged from the roof. In October 1977, the groundbreaking was held for the new pagoda. Relics of the Buddha, obtained from Gandhara in Pakistan, were enshrined under the central pillar in May

1978, and construction work on the pagoda was completed in October 1980.

Next to be rebuilt was the Central Gate (Figs. 22, 29), with construction beginning in 1982 and ending in 1984. Though considerably smaller than either the pagodas or the Golden Hall, it is still quite large by contemporary wooden construction standards. Each side of the gate contains a niche for a guardian statue. These sculptures, standing over five meters in height and originally made of clay, were reproduced in wood by Kannya Tsujimoto, a renowned carver and restorer of antique Japanese sculpture.

Prior to the completion of the Central Gate, Nishioka had produced basic designs for the remainder of the main complex, including the surrounding corridor, new lecture hall, refectory, bell tower, and sutra repository. The entire reconstruction project, barring any major interruptions, was expected to be completed in the year 2030. Because Nishioka was already in his late eighties, he concentrated on finishing the basic design work for the entire project and on ensuring that his apprentices were trained to complete the project when he was no longer able to participate. The work would thus continue posthumously in his name.

The ultimate aim of the Yakushiji project, however, was not restricted to the historical restoration of the temple to its eighth-century appearance. The final goal was to upgrade Yakushiji to the status of head temple of the Hossō sect, a position held by a Chinese temple until the Communist Revolution. The relics of one of the sect's founders, the Chinese monk Hsüan-tsang (Genjō Sanzō), were brought to Japan in the 1940s. In 1979, Nishioka, Professor Ōta, and

Abbot Takada took the first step toward the creation of a new complex to house these relics. The construction of this complex, properly known as the Genjō Sanzō-in, but referred to simply as the Sanzō-in, was decided upon at the end of 1979, prior to the completion of the new pagoda. In 1981, Nishioka once more traveled to Taiwan to select the trees.

Figure 31 Yakushiji in the late afternoon.

The Sanzō-in (Fig. 24, also Chapter 4) reproduces many of the features of the main complex in miniature. There is a Central Gate (Fig. 34), a surrounding corridor (Figs. 6, 42), and, in the center, the most important structure, an octagonal hall (hakkakudo), called the Genjō-dō at Yakushiji (Figs. 32, 39), which houses the founder's relics under a life-sized wood and lacquer image (Fig. 40). The other major building, which will be discussed in detail below, is of a type known as a "picture hall" (e-den) (Fig. 33), so named because the interior walls, and sometimes the ceiling, are decorated with educational or spiritually evocative paintings. In this instance, the pictures depict scenes from the Silk Road, a trade route that indirectly linked Japan with the Middle East through

China and India and played a vital role in the flowering of Japanese culture during the sixth, seventh, and eighth centuries. Hsüan-tsang himself had passed over this road in order to bring back sutras from India for the monasteries of China, and so it was deemed fitting that his Picture Hall should celebrate his travels. The ceiling has been painted with a design of the heavens.

The construction of the Picture Hall was begun following the groundbreaking ceremony for the Sanzō-in in November 1984, and was completed in 1987, except for the extensive religious murals, which were not finished until 2001. The Octagonal Hall was completed in late 1987, and the Central Gate in early 1988. A pair of Sutra Repositories (housing one million small wooden towers, each containing a copy of the Heart Sutra made by a worshiper), were completed in 1989, and the entire Sanzō-in complex dedicated in 1990.

Architectural work then recommenced on the main Yakushiji complex, in 1991. Nishioka lived to see the dedication and partial completion of the corridor surrounding the halls and pagodas of the main compound, but the largest structure, the Great Lecture Hall, was finished only in 2003, after Nishioka's death, under the guidance of his chief apprentice, Mitsuo Ogawa.

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"Don't try to join wood based on measurement alone, but utilize the wood's personality as well."

Every tree is an individual, though influenced strongly by its growing environment. Each tree develops a unique set of

characteristics, idiosyncrasies that can be called its “habits” or “personality.” A particular tree may be prone to twist clockwise because it was subjected to strong winds from the east while growing, while another may tend to bend as it releases tension caused by having heavier branches on one side as a result of how the sunlight reached it. If wood like this is mated with others that have opposing tendencies, the result will be structurally more secure and the finished building less prone to distortion. Accurate measurement cannot be overlooked, of course, but in itself it is not sufficient for good work.

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“The hearts of the carpenters should be matched in the same way the personality of wood is.”

Building a temple requires the effort of many people. Craftsmen have habits and idiosyncrasies just as wood does, and in order to build a unified team that works with one mind it is essential to recognize each carpenter’s individual tendencies and assign tasks that utilize them to best

advantage. Not only is it impossible to make each worker identical in ability, it is undesirable.

CHAPTER 4

TEMPLE DESIGN: THE SANZLŌ-IN

The design of Buddhist temples in China and Japan is a complex product of slow evolutionary change. Indeed, the resulting welter of cross-influences, hybridizations, alterations, and idiosyncrasies has been a source of endless scholarly debate. Despite this diversity, however, there has always been a tendency toward codification and standardization, particularly with regard to scale and proportion. In China, building design was first codified in the twelfth century with the publication of government building standards, superseded by a second important manual in the eighteenth century. Japanese carpentry manuals were similarly standardized in the Edo period (1603–1867). Carpenters throughout Asian history kept individual records as well, many of which have survived. Perhaps more important than written records, however, was the fact that an existing building's proportions are for the most part readily apparent to the naked eye, subject only to limitations inherent in the perception and analytical abilities of the observer. In other words, once the image of a building is firmly fixed in an expert carpenter's mind, he can, with some experimentation, reproduce it. Thus, for a carpenter like Nishioka, notations and measurements (important as they are) take second place to the mental images which inform his ideal of beauty.

Figure 32 The courtyard of the Sanzō-in, showing the Octagonal Hall and the Picture Hall behind it. The Sanzō-in is not a historical reconstruction but a new complex based on historical design principles. (See Fig. 41.)

Figure 33 The Picture Hall is seven bays wide, with five sets of large doors opening on the front.

Figure 34 The Central Gate of the Sanzō-in complex is simple but dignified.

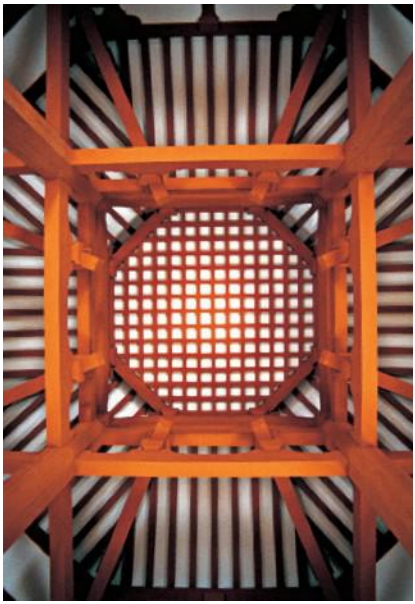

Figure 35 The ceiling and rafters of the Octagonal Hall.

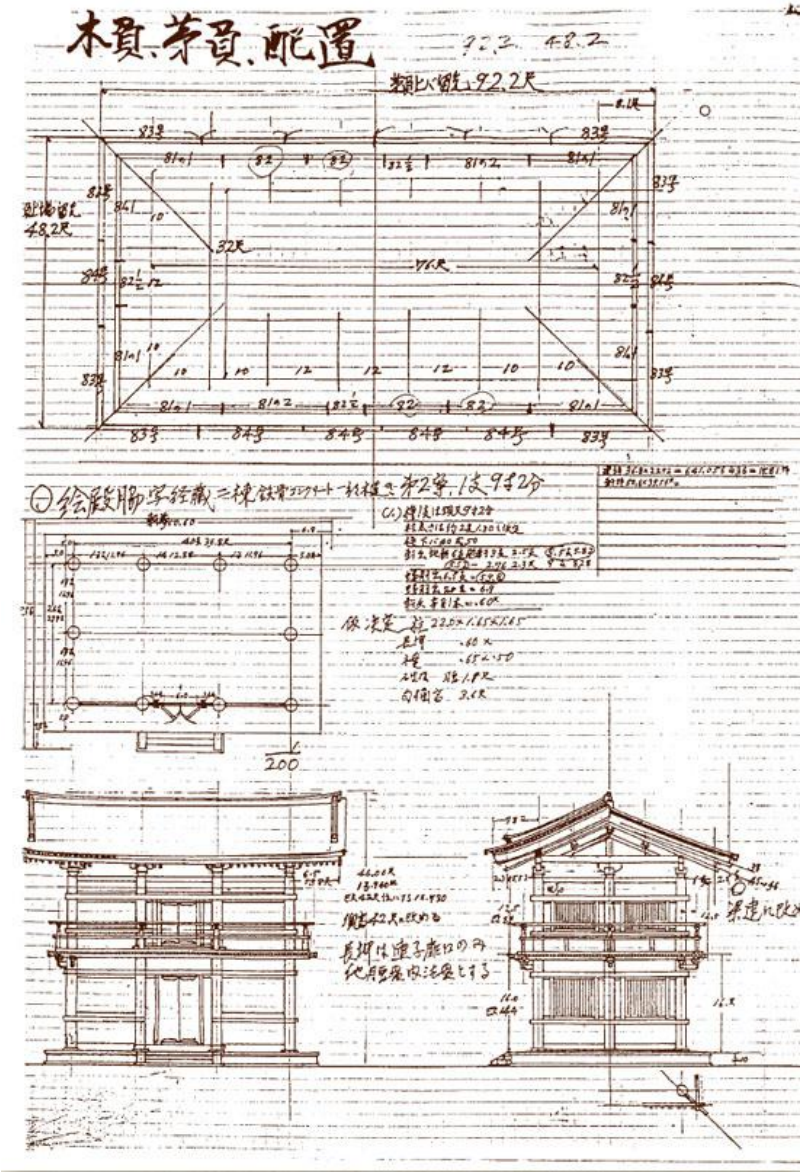
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Figure 36 A page from Nishioka's notebook dealing with dimensions and proportions of a sutra repository and the Picture Hall.

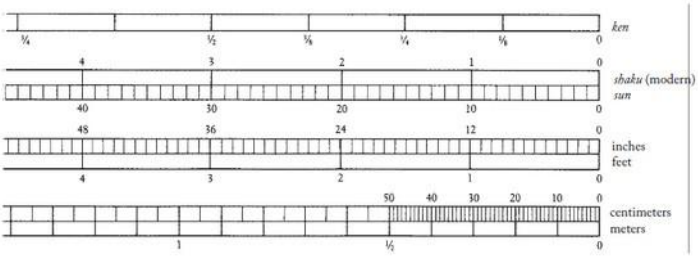

Figure 37 Relative scale of measurements. (The Nara-period shaku is 0.98 of the modern shaku).

The sense of beauty is to some degree culture-specific, and it took some 200 years of experiment and refinement for the Japanese to reshape borrowed Chinese aesthetic forms into configurations closer to their own ideals. Roof curves became more gentle, certain structural elements more delicate, and composition at times asymmetrical. By the time Yakushiji was built, the initial adaptive phase was almost complete. By the Kamakura period, beginning in the late twelfth century, a simple, economical style had been perfected that could be considered completely Japanese, the wayō style.

Most temple carpentry done in Japan today is historical reconstruction—as opposed to original design—which means it closely resembles detective investigation. This is true of the main compound of Yakushiji. Study of other temple compounds, such as Hōryūji, shows that each was intended as a coherent aesthetic entity, held together by shared details and proportional relationships. The master carpenters of ancient

times tended to apply the same formulae to all the buildings in a particular temple compound, but varied them more or less for other temples. Thus, temple compounds of roughly the same period show a high degree of individuality while retaining a certain generic kinship. The key to design reconstruction is to discover the original proportional formulae, and to reapply them harmoniously to several structures of widely differing sizes and plans. Proportional formulae generally fall into two categories. The first concerns the proportions of the site; the second, the proportions of the building's components themselves. These two systems are not, of course, independent; the overall layout of a carefully proportioned temple complex must be based on the overall sizes of its major buildings, which in turn are modified by their own internal proportional relationships. Archaeological and historical research is an invaluable aid in uncovering such formulae.

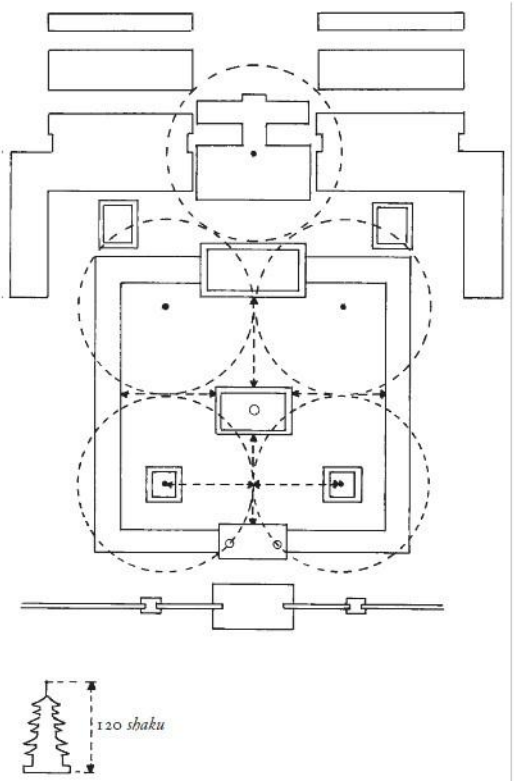

Figure 38 Proportional diagram of the Yakushiji main complex. The circles indicate major determinants, that is, 120 shaku or Japanese “feet” (the distance from foundation to finial of the East Pagoda).

One of the primary archaeological records are the original foundations, with the size and location of column base stones particularly reliable clues to the overall size of the building. Further valuable hints can often be found in pictorial and written records. At Yakushiji, the existing East Pagoda provided almost all the information necessary to rebuild not

only the West Pagoda but also the other buildings in the main compound. Such information included data on relations between column height and width, between column height and the size of bracket complexes, and between the spacing of main floors and "false" roofs, as well as such details as curve shapes and decoration. Early investigations showed that the temple layout as a whole was governed by a simple proportional system based on the height of a single pagoda (Fig. 38). This height, 120 shaku (the shaku is a Japanese standard of measurement that varies from era to era and in different parts of the country but is roughly equivalent to one foot; Fig. 37), dictates the spacing of the pagodas themselves, the dimensions of the surrounding corridor, and the placement of the other buildings within the compound. The interrelationship among the parts of a temple compound is such that very little information is necessary to reconstruct the layout of the whole, much as a paleontologist might reconstruct an entire dinosaur from a few bones.

Figure 39 The Octagonal Hall was built for the protection and veneration of the relics of the monk Genjō Sanzō

(Hsuan-tsang). It is the most technically complex building in the Sanzō-in.

Figure 40 The relics of Genjō Sanzō are housed beneath a life-sized statue of him in the center of the Octagonal Hall.

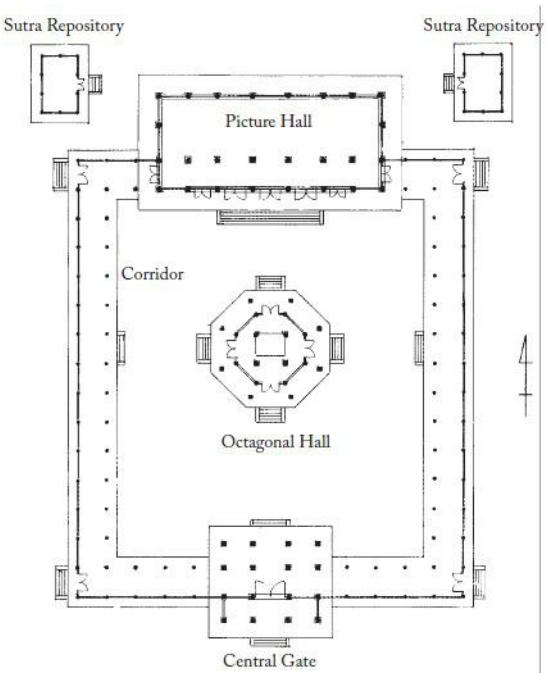

Figure 41 Plan of the Sanzō-in subcompound.

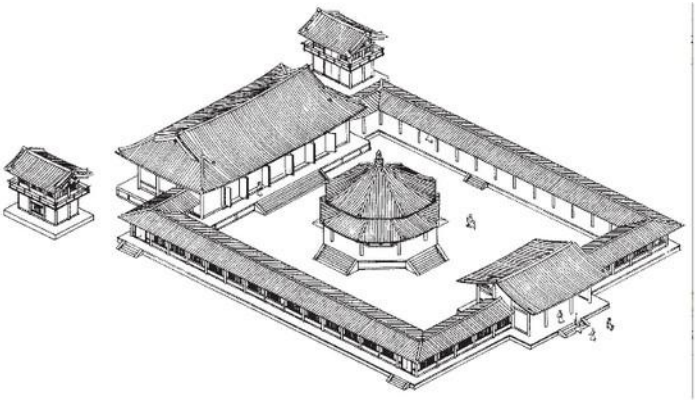

Figure 42 Axonometric of Sanzō-in.

Because the Sanzō-in is a new complex, the designers thought it unnecessary to follow the eighth-century style of Yakushiji's main complex. Rather, they viewed this as an opportunity to demonstrate construction in a later historical style, and settled on the Kamakura-period wayō style because of its relative economy and quintessentially "Japanese" nature.

Thus, for the Sanzō-in compound, Nishioka and Ōta produced an original design based on several historical examples, incorporating features drawn from all while maintaining consistent proportional relationships. The overall size of the complex was determined by several factors. First, the religious function of the buildings dictated the number of people to be accommodated, and therefore the approximate size. Next, available land and the projected budget were considered. The result was the largest possible group of buildings that could be built on the given site for the designated amount of money, keeping in mind the specific religious and technical design requirements. Some factors, such as the south-facing orientation, were dictated by Buddhist canon and design tradition. Additionally, the buildings had to meet the various requirements for ceremonies, processions, and the like. These aspects all have traditional solutions and extant models.

Figure 43 Uehara-san, Nishioka's chief assistant on this project, with duties similar to a foreman, was responsible for transforming the Master's measured drawings into full-sized templates, laying them out on the floor of this loft-like room. (See Figs. 49, 63.)

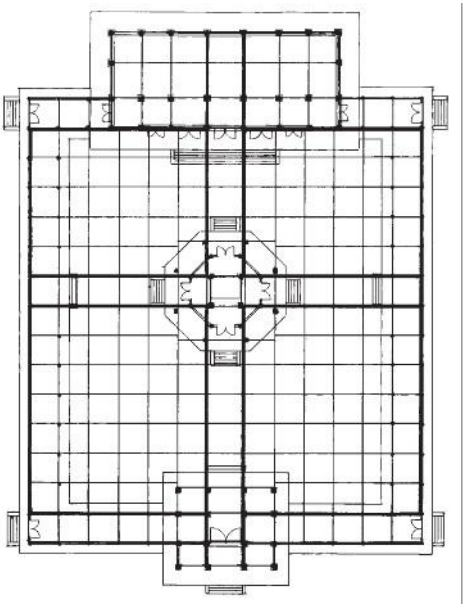

Figure 44 Sanzō-in proportional diagram. Major axes of the compound are plotted on an imaginary grid defined by column spacing. The grid module is roughly 10 shaku, but varies where necessary.

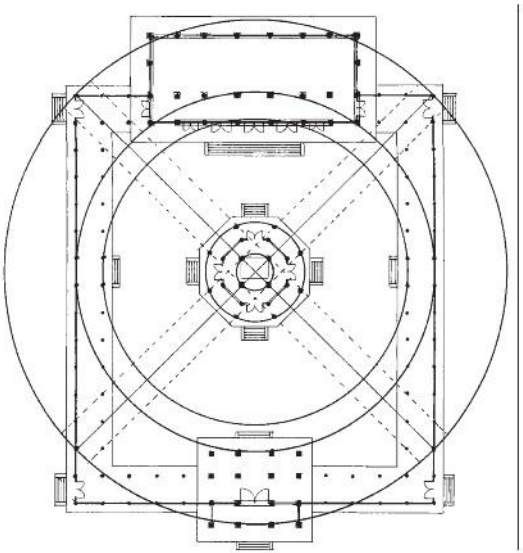

Figure 45 Sanzō-in proportional diagram. Major dimensions are plotted as circles centered on the relics in the Octagonal Hall.

After the overall layout was decided, the proportional formula was developed, and Nishioka began to apply it to the actual design, which underwent several revisions as details were established (Fig. 47). The Picture Hall was the first building to be erected and the first to be designed in detail. Nishioka made the necessary drawings and calculations in his notebooks (Fig. 36), and these were used to make a set of blueprints not unlike those used in any modern construction.

The actual building work was done in collaboration with a major construction company, Ikeda Kensetsu, which provided heavy equipment and logistical support, and also carried many of the carpenters on its payroll, though all were under the master carpenter's direction. It prepared and executed plans for reinforced concrete foundations, drainage, and temporary sheds within which carpenters could work unhampered by inclement weather. After a special groundbreaking ceremony in November 1984, the laying of the foundation began.

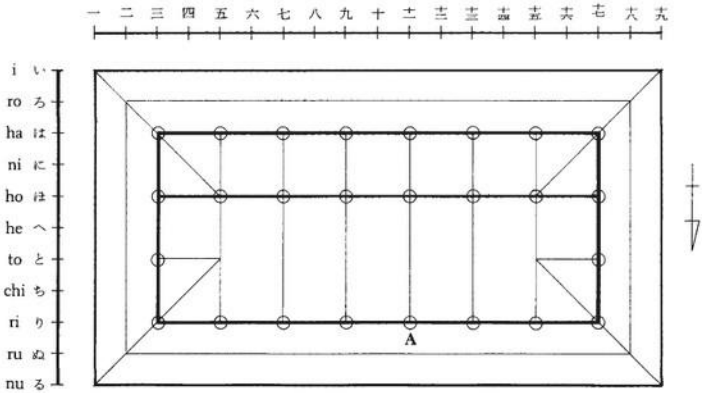

Figure 46 For convenience in labeling parts, carpenters use a grid system based on traditional numbers and syllables. A simplified version is shown. For example, the column marked A in the illustration is referred to as ??—, which reads ri jūichi ("ri eleven").

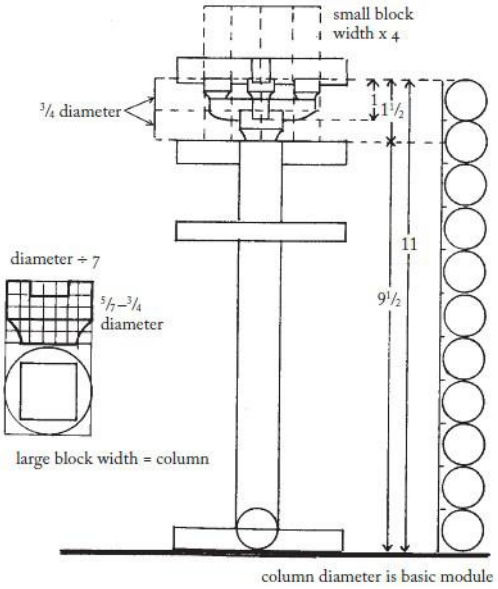

Figure 47 Proportions of column diameter and height, eaves, etc.

Figure 48 The courtyard of the Sanzō-in is covered with hand-fired grey tiles. The decorative pattern is based on the

lotus pattern used in the original Yakushiji roofing tiles. (See Fig. 239.)

At this point, Nishioka's drawings were passed on to his chief assistant. Although it is conceivably possible to make the parts directly from printed plans, temple carpenters traditionally use extremely precise full-size wooden templates (Figs. 49, 63). The fabrication of these is the chief assistant's job, and requires the ability to visualize complex three-dimensional intersections and to project them onto two-dimensional surfaces. Every detail of every part must be thought out at this stage and recorded on the templates.

Many parts have compound curves, that is, they curve in both plan and elevation. These curves must be accurately visualized and described at this stage. In addition, when such curved parts intersect with others (often with two or three at the same point), the joints must be indicated in detail on the templates. Lastly, information pertaining to true horizontal and the ultimate height of the part from ground level—constantly checked during construction—must be included.

This work is performed in a special room with a smooth floor onto which the plywood sheets are tacked (Fig. 43). The chief assistant lays out the various elements in pencil and sumi ink, with the help of squares, inking lines, and other wooden templates. During this process, the relationships among the separate parts are continually checked by placing one sheet over another, like drawings. When the layout is perfect, the templates are meticulously cut out by hand and delivered to the assistant master carpenters. These templates are preserved for use when repairs become necessary in the future.

Figure 49 Wooden templates used in fabricating parts. These are for the Octagonal Hall.

CHAPTER 5

SELECTING THE WOOD: RULES OF THUMB

During the ages when timber was in ample supply, a Japanese carpenter could be assured of adequate prime building material close to home for all but the largest projects. Over the centuries, several rules of thumb evolved concerning the optimum use of wood, which reflected the value placed on continuity between the wood's natural, living state—what Nishioka referred to as utilizing the "personality" of the wood—and its ultimate disposition within the erected framework. Although the poor state of forest resources in Japan today has made strict observance of these principles impossible, they remain as ideals.

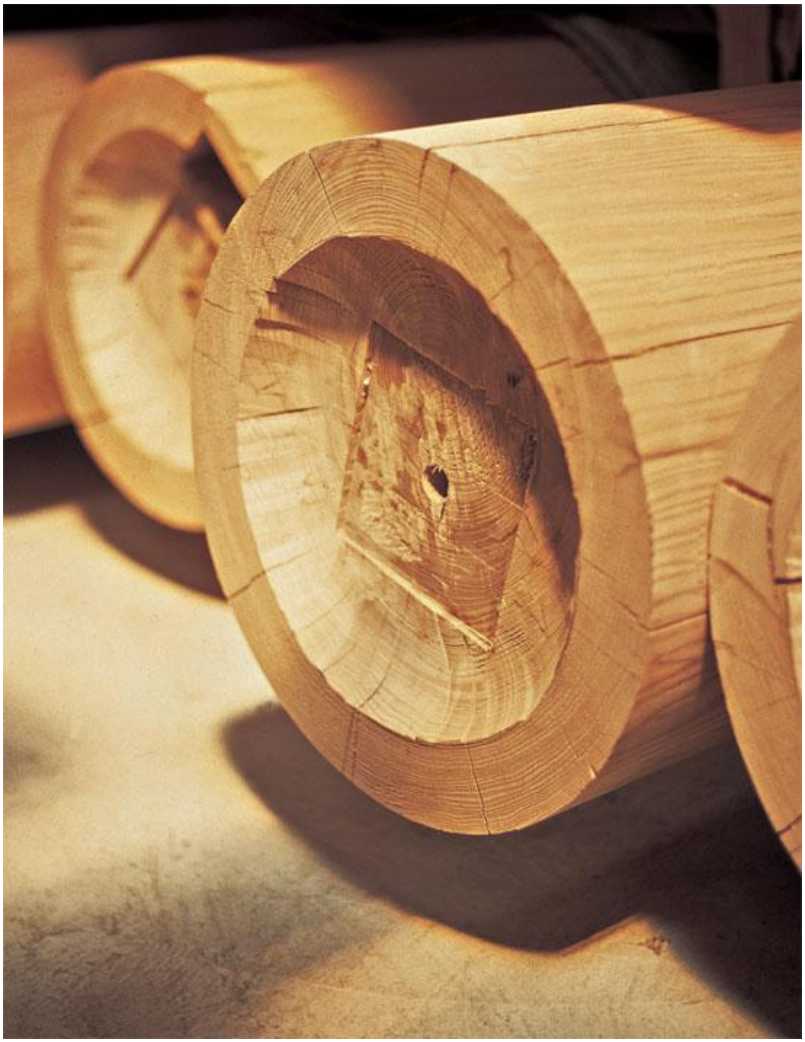

Figure 50 Completed columns for the Picture Hall, each from a single tree.

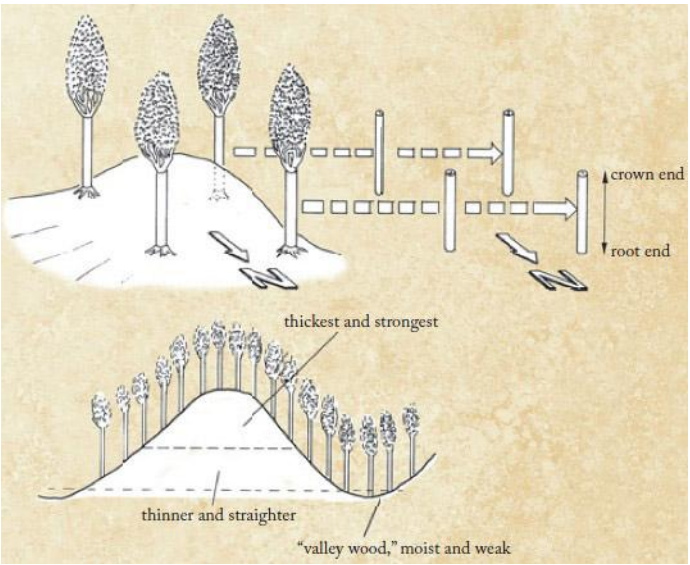

Figure 51 The tree's position on the mountain results in different characters of wood. Structural members, particularly columns, should be used in the same orientation they had when alive on the mountain. "Valley wood," the product of a moist environment, is only suitable for ceilings, etc.

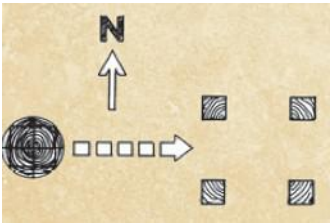

Figure 52 Orientation. If smaller dimension posts are to be used, those at the corners should be taken from the same tree and placed in the same relative positions.

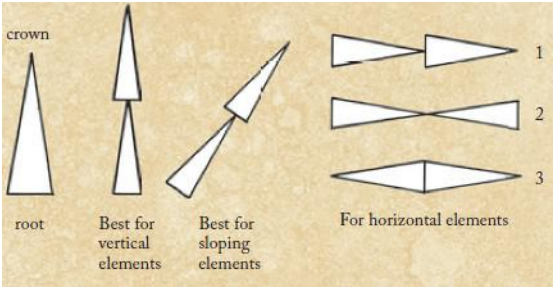

Figure 53 Crown and root joints: 1. Root-to-crown joints are not as good as crown-end joints in horizontal elements such as ridge beams but are preferred in certain cases. 2. Those with crown ends together are preferred. 3. Joints with root ends together should be avoided.

Many of the carpenter's rules of thumb are based on geomancy, derived in large part from Chinese principles. Geomancy seeks to identify the various natural forces acting on a building site and to compensate for any perceived imbalances. In the tradition under which Nishioka was raised, the principles are called "Shishin" or "Four Gods." For instance, according to Nishioka, the ideal building site has a mountain to the north, a river to the east, a pond or lake to the south, and a straight road to the west, each represented by a deity (see page 13). When I asked how valid he thought these principles were, he remarked simply: "The Hōryūji site conforms to these rules perfectly, and the temple is almost entirely intact. Yakushiji's site has no mountain to the north and no pond to the south, and only one building—a pagoda—has survived." The evidence apparently spoke for itself. Deficiencies in the site, however, can be compensated for. If the needed river is missing, seven willow trees (a tree usually found close to rivers) should be planted in the

specified location. In place of a pond, seven paulownia trees may substitute; for a road, seven plum trees; and for a mountain, seven enju trees, a variety of legume.

Carpenters extend the geomantic principles to human relations as well: a certain balance of personalities is required among crew members just as among pieces of timber if a project is to result in the creation of unity. “The carpenters,” said Nishioka, “should all know what will be expected of them, what the goals of the project are. In order to do this, they should try to become one with the master’s heart.”

ORIENTATION

Depending upon its position on a hillside, a tree will be exposed to different conditions of sun, wind, moisture, and so on. Consequently, care is taken to maintain the compass orientation of the timber in the finished building, particularly in the case of columns (Figs. 51, 52). For instance, trees that received strong sunlight due to their location on a southern slope are best used as columns on the southern face of the building. A tree’s structure is naturally designed to resist gravity, being thicker and denser at the base and thinner and lighter at the crown. This vertical relationship should also be maintained, base end always down, crown end always up. In addition, where possible, horizontal members should be joined crown-to-crown (Fig. 53). This is true of inclined members as well.

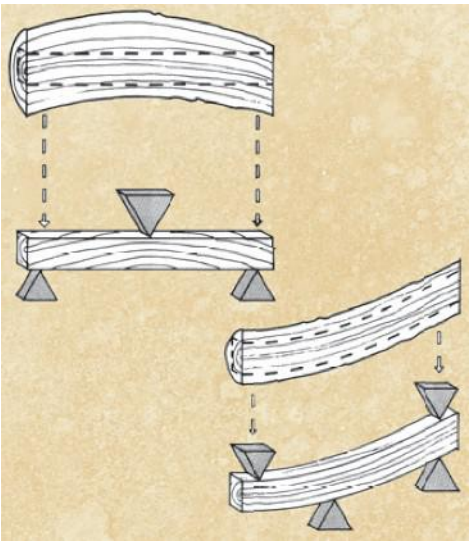

Figure 54 On the left, the grain acts as a natural arch, resisting the center load. On the right, the grain is an asset when the member bears a cantilever load.

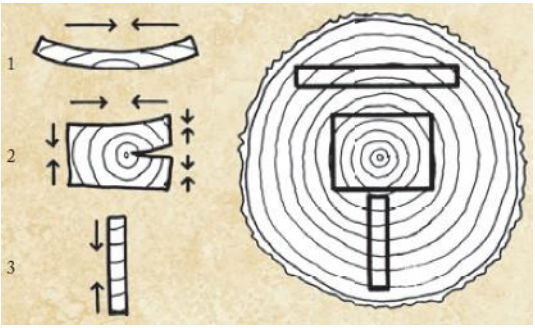

Figure 55 Arrows show the direction of shrinkage. No. 3. is the most stable dimensionally.

A tree's location while it is growing affects its usable characteristics in other ways as well. According to Nishioka, the strongest trees grow above the midpoint of a mountain, where they receive the best sunlight and the greatest air circulation (Fig. 51). The trunks are thicker since the trees there are able to branch quickly and fully and develop the necessary girth to support a large amount of leaves or needles without excessive competition from neighbors. These trees should be used for columns. On the other hand, trees that stand below the midpoint, where they must compete for sunlight with trees above and thus send their trunks higher before branching, are a source of thinner logs that are relatively free of knots. These logs should be used for exposed members requiring a fine surface. Trees growing in valleys produce inferior lumber of high moisture content, but are nonetheless usable for ceiling boards and other parts requiring neither strength nor fine finish.

MOVEMENT AND SHRINKAGE

All wood changes shape in response to changes in temperature and moisture. The greatest movement occurs perpendicular to the grain when viewed from the end, that is, radially. Lumber should be milled so as to minimize shrinkage-related distortions, and to insure that the changes that do occur are predictable and can be accounted for in design (Figs. 54, 55). Logs with twisting grain should be used in opposing pairs so that their movements counteract each other.

???????????? ?????????

“Only a compassionate master can mold his carpenters into a unified team.”

Nishioka believed that compassion and deep understanding were the most important virtues for a master carpenter to possess. A master lacking compassion will be unable to shape his workers’ thinking in a way that will enable them to successfully execute the highest quality work.

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“One hundred carpenters means one hundred ways of thinking, and only a master of high caliber can bring them together and tell them what is correct.”

Each carpenter will have his own ideas about the best way to proceed with the work, and the ability of the master to bring them together depends on his leadership skill. Though the process takes time and requires compassion and understanding on the master’s part, once he has communicated his own thinking sufficiently to each worker, he will be able to move them all in the right direction.

CHAPTER 6

FABRICATING THE PARTS

The main workshop for this project is a vast metal-roofed structure not far from the main Yakushiji complex and adjacent to the Sanzō-in. It is dirt-floored and warmly lit by sunlight filtering down onto the workers from a dozen or so translucent panels (Figs. 56-59). There is, of course, electricity for lights and power tools, and large doors on all sides admit additional light as well as timber-laden trucks and forklifts. The workshop is much quieter now than when Nishioka was alive. Then, one tiny room served as a rest area, with large tea decanters, shelves for personal effects, and, in winter, a kerosene stove. In summer, there was no respite from the heat. A nearby shed of similar dimensions functioned as a painting room and storage for finished parts. A third large building was jammed with enormous logs undergoing a three-year seasoning (Fig. 62). Building materials were constantly being shifted from one shed to another, ultimately finding their way to the construction site and into their predestined locations in the finished structure, marking the end of a process that began several centuries and thousands of miles away when the logs were seedlings on a Taiwanese hillside.

Activity in the workshop was never frenzied, but progressed at a steady and deliberate pace on several elements at once, rarely falling behind schedule. If a deadline seemed to be approaching too quickly, extra hours were added to the work week, an option considered infinitely preferable to rushing the work.

Figure 56 A carpenter shapes a column with a chona (adze).

Figure 57 The gable end beams present a particular challenge as the horizontal beam is not straight but curves upward gently at the ends. The joints must be fitted to accommodate this. (See Figs. 70, 205, 210.)

Figure 58 Bracket complexes being fabricated as identical sets. (See Figs. 138-148.)

Figure 59 Much of the initial work on parts like columns is done with basic tools like axes and adzes. A skilled carpenter can wield these tools very precisely.

Figure 60 The axe leaves rhythmically spaced tool marks on the face of this column.

The actual fabrication of an element begins after the completion of its template, which the chief assistant then passes on to one of the assistant masters. The logs to be used for major components, such as the columns and huge hip rafters, have been selected and marked in advance. The lumber for other particular components is chosen at this point, the first stage in a process known as ki-dori, or wood preparation. Here, the carpenter must examine such characteristics as wood grain and knots, and try to predict how the wood will change. He must visualize the finished components that lie dormant within the rough lumber, and do so in such a way as to take full advantage of each log's idiosyncrasies. Many carpenters consider this to be the single most important stage of their work. The skills it requires are not physical but mental: imagination, visualization, and an intuitive grasp of the wood's "personality."

Ki-dori proceeds in several stages as each log is reduced to smaller and smaller components. The primary milling is conducted at a nearby sawmill, and the lumber transported back to the workshop, where the smaller pieces are roughly cut on large-capacity band saws and table saws (Fig. 64). Since most components come in sets, usually several pieces of rough lumber identical in size and configuration need to be cut. They are then moved to a corner of the shop.

The workshop is spacious enough for about eight different major operations to be carried out simultaneously. Generally speaking, one assistant master undertakes the fabrication of an entire set of identical components, assisted by a junior

apprentice from time to time. The carpenters confer with each other frequently, but interference in another's project is taboo. Each takes full responsibility not only for his own work but that of his helper.

After basic preparation, the information from the templates is transferred to the pieces to be cut. This is called sumitsuke, or layout (Fig. 63). Using the templates and shop drawings as a guide, cut lines and other notations are transferred to the workpiece in ink. The primary layout tools include the inkpot and line, metal square, and bamboo marking pen. Marks are made in black ink, with occasional notations in red. The ink is indelible, so any corrections require previous notations on the wood surface to be planed off. Generally speaking, identical parts are all laid out at once, but this is a matter of personal choice. The indelibility of the ink is an asset for future restorers, who frequently refer to the original labels and notations. Disassembly and reassembly, as well as tracing the original function of a piece that has subsequently been moved, are all facilitated by adequate notation.

Figure 61 Fabricating ridge beams in the main workshop. (See Figs. 196, 200.)

Figure 62 Taiwanese hinoki logs stacked for seasoning. The one in the foreground is nearly two meters in diameter.

Initial shaping is now usually done with power tools, but it can be carried out by hand. Use of power tools is discouraged until the apprentice has mastered the requisite hand tools. The aim is to provide the carpenter with as many options as possible. It is not uncommon to see a carpenter laboriously cutting or planing a board by hand when an electric tool would be faster and equally accurate. Hand tools, particularly Japanese hand tools, provide a tremendous amount of subtle tactile information about a particular piece of wood. The delicate readings and detailed observations possible when working slowly by hand are lost with a noisy, dangerously gyroscopic blade or drill. But again, the choice of tools is personal. The apprentice sometimes finds himself the victim

of conflicting suggestions, forced to remember each of his seniors' predilections in order to avoid criticism. Fundamentally, there is no operation that cannot be carried out through the judicious application of saw, hammer and chisel, and plane.

One remarkable fact, alluded to above, is that each carpenter works in relative isolation. His templates, plans, and knowledge constitute only a partial picture of the overall interrelationship among the parts. When instructed to provide a mortise, he provides it; when instructed to shape a compound curve, he shapes it. While it is dangerous to generalize, it is probably safe to say that a Westerner, particularly an American, often finds it difficult to perform complex work without understanding exactly how his job relates to the whole. As a result, he asks a lot of questions. There is, perhaps, an underlying belief that if one understands the overall intention, one may be able to avoid errors or even improve upon the design of one's superior. This does not seem to be the case with the Japanese carpenter. He may not always know who is making the tenon that will fit his mortise, or why the curve is necessary, but he is fully confident that if instructions are followed, the pieces will fall perfectly into place. In short, he trusts not only his superiors but his colleagues, as well as the system in which they work. This is an outgrowth of, and the reason for, the long apprenticeship.

Figure 63 Kogaitō-san, an assistant master carpenter, does an initial layout with the aid of templates, a steel square, an inkpot and line, and a bamboo marking pen.

Figure 64 The carpenters do use machinery on occasion, particularly for milling wood to rough dimensions.

Each piece requires several successive operations of cutting, trimming, and smoothing, with the final surface for exposed pieces demanding increasingly finer planing to achieve a glasslike smoothness (Fig. 66). The finished components are then handed over to the painter.

As mentioned above, painted architecture was an innovation brought to Japan from Korea along with other techniques in the sixth century AD. The Japanese people had up to that time constructed durable structures of unpainted wood, and in fact even today a natural wood surface, color, and grain are an important enduring Japanese aesthetic. After painted Buddhist architecture had taken root and evolved in Japan, unpainted wooden temples began to make their appearance, and many of them have now withstood the test of centuries. I believe it is safe to say that painting is not required for protecting the wood, and this applies particularly to hinoki, but is an aesthetic choice.

There were relatively few pigments available in ancient times. Red was obtained from iron oxides, green from copper oxide, yellow from earth, white from the calcium in bones and seashells, and black from carbon. Bright blues were precious, requiring lapis lazuli, but dark blue could be obtained from indigo. In eighth-century Nara, temples were usually painted red overall, with green and white details. Ceilings often featured complicated floral patterns in a variety of colors against a white ground. These principles were followed at Yakushiji.

The painting is usually carried out by one man, perhaps with a single assistant, who begins by mixing the colors from natural dry pigments, water, and a seaweed-derived binder. He then coats the areas of the individual components that are to be exposed, leaving the other surfaces bare. A few days are generally allowed for the paint to dry completely before another coat is added. Four coats are applied in all, and then the pieces are stacked to await final assembly.

Figure 65 Rough cutting material on an industrial-grade machine.

Figure 66 Hayashi-san applies a hand plane to an outside horizontal brace beam. The shavings are tissue paper thin and several meters long.

CHAPTER 7

SECRETS OF ENDURING CARPENTRY

Temple components are relatively large but their dimensional tolerances are very fine, particularly in the case of surfaces that will remain visible. Allowances must be made for wood movement: expansions and contractions due to changes in temperature and humidity; gradual deflections under load; cumulative shrinkage from moisture loss in the wood's inner cells. For these reasons, craftsmen speak of wood as alive and breathing.

One level of mastery lies in accuracy: straight lines are perfectly straight, joints snug, curves gradual and even. Another level entails the same degree of accuracy but takes wood movement into account. Will this joint still be snug a hundred years from now? Will this curve remain attractive after sagging under a century of load? Here are a few examples of the kinds of details, often undetected by the untrained eye, that set master carpenters apart.

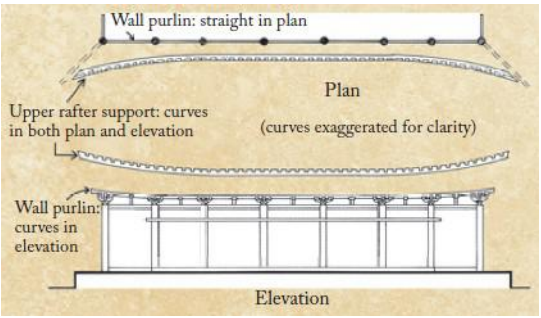
Wall purlin: straight in plan
Plan
(curves exaggerated for clarity)
Upper rafter support: curves in both plan and elevation
Wall purlin: curves in elevation
Elevation

Figure 67 Curves achieved without bending the wood. The gradual transition from the horizontal tie beam to the graceful upward sweep of the eaves occurs in several stages. The first compensation is made at the wall purlin, which is about four centimeters higher at the ends than in the center; the upper surfaces of the corner bracket sets are slightly beveled in order to accommodate this curve (Figs. 147, 148, 156). The wall purlins are not bent but shaped to the proper curve (Fig. 185). The upper rafter support and the eaves support are composed of linked segments that form a more pronounced compound curve. This curve, evident in both plan and elevation, is also formed without bending the wood. (See also Figs. 185, 193.)

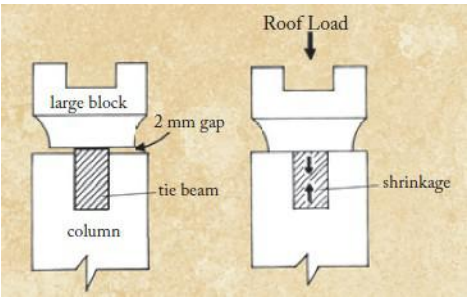

Figure 68 Upper column area. Here we see another typical example of compensation. The columns and tie beams, which must eventually lie flat and evenly support the large block above, are constructed with a two millimeter difference in height. The tie beam will shrink and be compressed by the roof load, giving the column and tie beam the desired flat surface. The illustration on the left shows the proper shrinkage allowance, that on the right the desired final configuration.

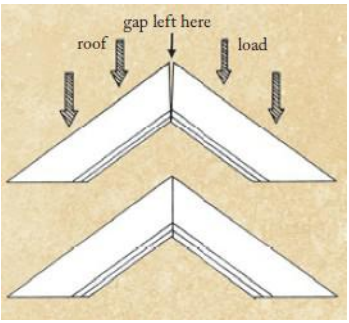

Figure 69 Similarly, a small gap left at the point where the two gable fascia meet will close as the roof settles. If this were not done, a gap would eventually appear on the bottom of the joint.

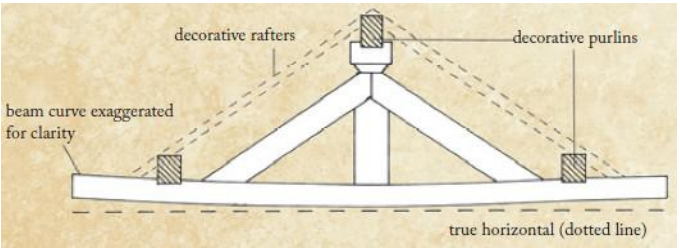

Figure 70 The gable area illustrates another type of detail. The “horizontal” beam at the base is actually curved, so that the enclosed area is not precisely triangular and therefore cannot be laid out as such. This complicates the treatment of the joints between the diagonal braces and the lower beam. (See also Figs. 57, 208, 210.)

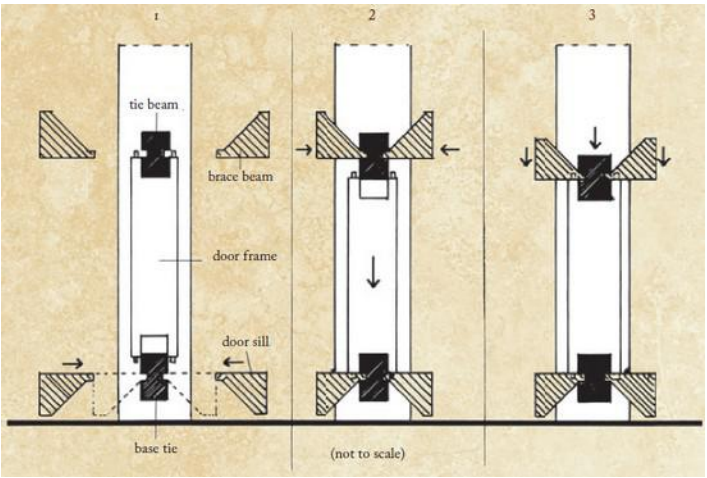

Figure 71 The door sill, subject as it is to damage from water and visitors' feet, is usually the first part to be replaced. The entire piece is thus designed to be removable.
1. Both door frame and upper penetrating beam are slid upward to allow the door sill to be inserted.
2. The door frame is slid downward, engaging the door sill with small tenons. The upper brace beams are inserted into the tie beam.
3. The tie beam is slid down, engaging the brace beams with small tenons at the top of the door sill. The tie beam is wedged into place. Removal procedure entails the replacement of a small section of mud wall above, a relatively simple matter. (See also Figs. 3, 136, 137.)

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"A master who lacks the ability to turn one hundred voices into one should fear for the work and respectfully resign his position."

Possessing superlative carpentry techniques is not enough for a master. He bears a heavy responsibility for the successful completion of the temple, and needs to exhibit compassion and understanding toward his workers at every moment. A person incapable of bringing such a group together should not even try to become a master carpenter.

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“Don’t attempt to learn every technique in one day. Recognize the superlative virtues our forebears possessed, and never forget them or the blessings they have left us.”

By following these precepts, it is possible to construct a fine temple, but a carpenter should not be deluded into thinking that he accomplished it on his own. Nishioka frequently called attention to the fact that the carpenters of ancient times accumulated centuries of knowledge that came from experimentation, discovering the right way to do things, and transmitted this knowledge to our generation. For that we are all indebted. We could not have done it on our own. And the debt we have incurred means that we must thank the gods and

pass on the knowledge as intact as we can to future generations.

CHAPTER 8

TOOLS

It is sometimes said that the tool is the soul of the Japanese carpenter just as the sword was the soul of the samurai. The comparison is apt in many respects. To be more specific, the tool is the means by which the carpenter leaves a trace of his spirit on the soul of the tree, the medium through which a marriage of souls is brought about. As a result, carpenter and tool serve each other, and together they serve the tree. There are regular occasions, such as at New Year, when the carpenter expresses his gratitude for the service his tools have rendered. Offerings of sake and rice cakes are made, and the carpenter promises, despite the great abuse his tools have endured, to treat them with greater respect in the future.

During the Asuka period, when the first Japanese Buddhist temples were built, only four types of carpentry tools were in use: curved bladed chisels, axes, adzes, and "spear planes" (yariganna). Today, an accomplished carpenter possesses a few dozen chisels, a dozen or so saws, a similar number of planes, a couple of axes and adzes, four or five hammers, eight or nine layout and marking tools, several sharpening stones, and assorted other tools. In addition, the modern carpenter has at his disposal a variety of power tools: saws, drills, planers, mortisers, screwdrivers, wrenches, and so on. Nevertheless, the hand tools remain essential to his work, and in all cases they reflect a preindustrial way of thinking about wood and steel carried to the extremes of refinement and subtlety.

Figure 72 Master Nishioka setting out his yariganna (spear planes).

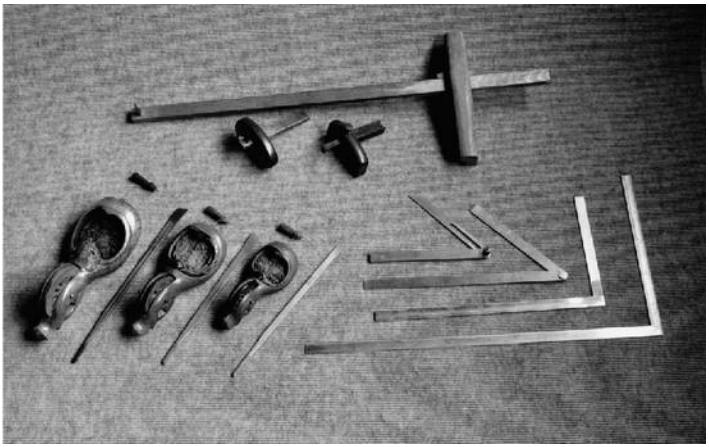


Figure 73 Layout and marking tools. Top: One large and two small marking gauges. Lower left: Three inkpots with line and bamboo marking pens. Lower right: Two steel adjustable bevel gauges, a small square, and a regular square.

Since the heart of a tool lies in its steel, preindustrial tool-making, like swordmaking, necessitated a time-consuming process of lamination of hard and soft steels to create the required characteristics of rigidity and resiliency, which are not unlike the characteristics of wood. Often this affinity between steel and wood is emphasized in the design of the tool, where the laminations stand out in a pattern reminiscent of wood grain.

“Modern steel is no good,” Nishioka said. “Swordmakers have always tried to find antique steel to use. A famous swordmaker ... once told me that good tools could probably be made out of nails from Hōryūji.... I had a plane blade made from some, and used it on the reconstruction of the Hōryūji Golden Hall” (Tsunekazu Nishioka, Ki ni Manabe, Tokyo:

Shōgakkan, 1988, pp. 26–7). According to Nishioka, the ancient steels were produced from rich ore smelted at relatively low temperatures, resulting in a resilient metal that cannot be reproduced from the depleted ore available today.

MARKING TOOLS

Steel squares, which are available in both metric and traditional Japanese measurement scales, are thinner and more flexible than those generally used in the West, and they include markings to enable complex calculations to be done easily onsite (Fig. 73). Adjustable bevel squares were introduced from the West in the modern era, but were modified to suit the Japanese preference for thinner, all-steel tools. The inkpot and line, similar in function to a Western chalk line, is equipped with a reservoir filled with ink-soaked cotton for inking the line and dipping a bamboo marking pen into. The line, after being secured to one end of the piece to be marked, is drawn tautly through the ink and flicked onto the wood, leaving a crisp ink line. These inkpots can be very ornate, and are sometimes carved with a miniature turtle (a symbol of longevity). Traditionally made of wood, the more common versions are now of plastic. The most frequently used ink colors are black and red. Adjustable marking gauges, available in many sizes, are used to inscribe lines at a set distance from the edge of a board. Some versions can scribe two or more lines. All consist of a rounded piece that fits in the palm and is slid along the edge of the piece to be marked. Through this rounded piece slides a wooden arm with a small steel scribing blade at one end. The arm is held in place by a small wooden wedge that is adjusted by tapping with a mallet.

AXES AND ADZES

Axes and adzes, which come in several sizes, are used for quickly removing large quantities of wood. In trained hands they can do extremely fine work (Figs. 74-76). All have a wooden handle fitted to a socket in the laminated steel blade. Proper operation of the adze requires a handle that is curved to fit perfectly the individual user's body and places the cutting edge at the optimum angle. Bending the adze stock to the proper angle is a small art in itself, accomplished with the help of water and sunlight. A perfectly curved stock assures flawless performance.

Figure 74 Axes and adzes. From left: Two small axes and three adzes.

Figure 75 Axes, like this one, are high-grade, hand-forged tools for precise carpentry work.

Figure 76 The curved handle of this adze (chona) was made by its owner to suit his own body.

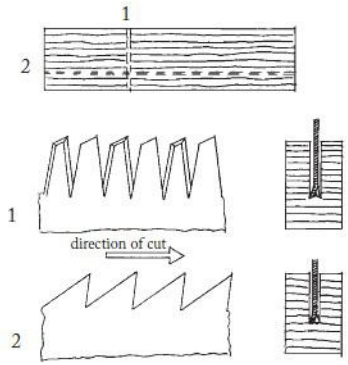


Figure 77 Saws. 1. Crosscut: The teeth have three distinct cutting surfaces (slightly different for hard-wood and softwood). 2. Ripping: Similar to the Western ripsaw (tooth angle slightly different for hardwood and softwood).

Figure 78 Saws. Top: Crosscut saw for rough work. Bottom, from left: Ripsaw for rough work; two single-edged crosscut saws; two double-edged saws for both ripping and

crosscutting; extra-fine crosscut saw for cutting tenons; curved double-edged saw for starting at the middle of a board; two "keyhole" saws.

SAWS

From the hefty ones wielded by lumberjacks to the tiny ones employed for detailed work in such tight places as the inside of wooden plane blocks, saws come in numerous sizes (Fig. 78). The two main types, crosscut and ripping, are distinguished by the shape of their teeth (Fig. 77). All of them cut on the pull stroke, which allows the blades to be relatively thin (since steel is strongest in tension) and places a smaller physical burden on the carpenter. As with all good Japanese tools, the best blades (and many of medium quality) are still made by hand. Wooden handles and other fittings can be purchased, though they are preferably fashioned by the user to suit his own taste. Observed Nishioka, "Maybe Westerners think the added accuracy [provided by the thin blade of a Japanese saw] doesn't make any difference.... But then, an electric saw can cut pretty well, too, you know. It doesn't care if the wood is soft or hard!"

CHISELS

There are several varieties of chisel, distinguished primarily by their cross-section and the length of the blade, and by whether the chisel is designed to be struck with a mallet or pushed by hand (Fig. 79). Ranging in width from a few millimeters to about five centimeters, blades are attached to the wooden handle by a thick tang. Two different steels are laminated to form the blade, a harder one for the actual cutting edge and a softer, more flexible type for the back (Fig.

80). The resultant blade holds a polished edge well and resists cracking under stress.

Figure 79 Chisels. Top row, from left: Two paring chisels or slicks; 200-year-old long-handled chisel; four butt chisels; two short butt chisels; two thin chisels. Bottom row, from left: Four mortise chisels; two round chisels or gouges; long-handled detail or dovetail chisel; crooked or trowel chisel.

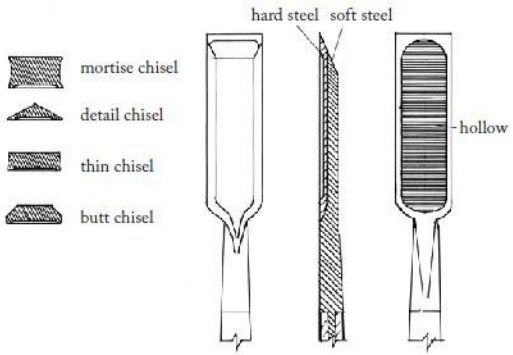


Figure 80 Chisels: Many sizes and shapes are made for specialized uses. They are laminated of hard and soft steel.

Figure 81 Planes. Top row, from left: Two long "common" planes; two short "common" planes; right- and left-hand corner planes. Bottom row, from left: Miniature compass plane; miniature rounding plane; miniature blunt-nosed plane; scraping plane; plow plane; pointed side-shaving plane; rounding plane.

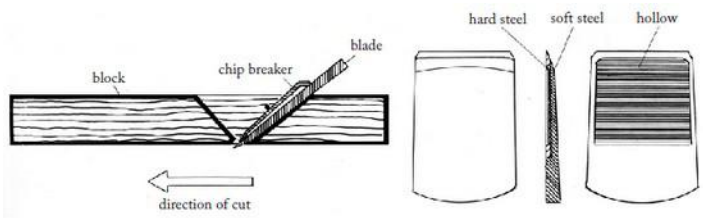


Figure 82 Despite their wide variety, Japanese hand planes are essentially a laminated blade set in a wooden block.

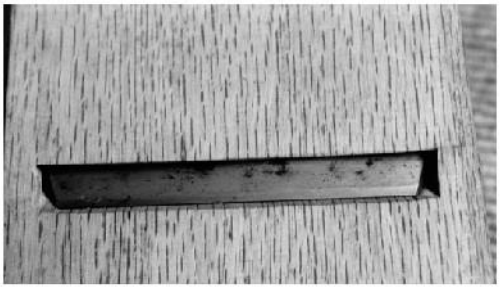


Figure 83 Detail of the sole of a plane, showing the “mouth” and protruding blade.

PLANES

Like Japanese saws, Japanese planes (Fig. 81) work on the pull stroke. They consist of a laminated steel blade fixed in a wooden body. The “common” planes are of many sizes and proportions as well as details of sole design, depending upon whether they are intended to remove wood quickly or to produce the smoothest surfaces. There are other varieties designed for rabbeting, forming curves, beveling corners, and producing shaped moldings, dadoes, and so on. The smallest is the size of the little finger. A well-tuned plane is capable of removing shavings as thin as ten microns and is probably the most difficult tool to master.

SPEAR PLANES

The “spear plane,” or yariganna (also sometimes translated as “planing knife”), is the ancestor of the present-day block plane, which did not appear in Japan until the sixteenth century. Shaped somewhat like a spear (Figs. 84, 85), it is used in long, gentle, slicing strokes to smooth wooden

surfaces, producing a slight undulation that is very soft to the touch. Nishioka revived the spear plane after centuries of disuse in order to recreate the original finish of the wood surface at Hōryūji and Yakushiji. It can now be found all over Japan. “The spear plane and the electric plane are designed to do the same job,” Nishioka observed. “The electric plane removes wood more quickly, but the spear plane, even though it was designed over a thousand years ago, leaves a surface that stays smoother much longer. Because the cut is so clean across the cell walls of the wood, water doesn’t enter and the wood resists mold” (Tsunekazu Nishioka, Ki ni Manabe, Tokyo: Shōgakkan, 1988, p. 30).

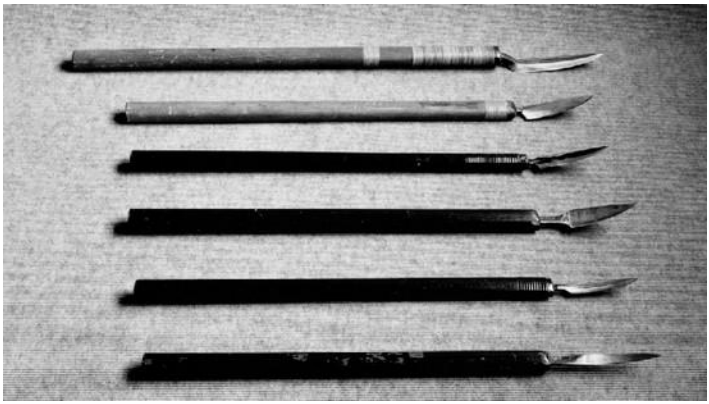


Figure 84 Nishioka’s tool chest contained several kinds of yariganna.

Figure 85 Some yariganna curve upward, some downward, depending on how they are intended to be used.

Figure 86 Hammers. Five types of hammer and a mallet.

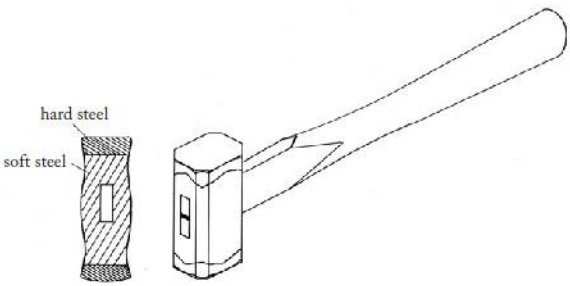


Figure 87 Hammer head. The flat face is used for striking chisels and driving nails, the slightly curved face for sinking nails.

HAMMERS

Hammers are employed primarily for driving chisels and secondarily for driving nails (Fig. 86). Available in several weights and with a variety of head shapes (Fig. 87), they exhibit a number of subtle design features and can be quite decorative. The largest are the sledge hammers for driving spikes and the massive mallets for nudging wooden members into place.

SHARPENING STONES

Sharpening stones (Fig. 88), which are used with water, are found in varying degrees of coarseness. The stone is fitted to a wooden holder. It generally takes three stones of progressively fine grit to true an edge. Occasional resurfacing is done with a powdered abrasive on glass. At the end of the sharpening process, a steel plate is employed to achieve a high polish. In recent years, synthetic stones have become quite common.

Figure 88 Sharpening stones.

CHAPTER 9

MAKING A JOINT

During the early periods of civilization in both Europe and Asia, the connection of wooden structural elements posed a great technological challenge. Throughout the world, Stone Age people usually met this challenge by lashing timbers together with strong fibers such as vine or strips of tough bark. As stone tools developed, primitive joints were fashioned by gouging out holes for the insertion of roughly shaped tenons. With the advent of bronze tools, and later iron, wood joinery attained forms familiar even to us today, and experimentation led to the invention of splices, intersections, dovetails, and means of joining flat panels. In Western civilization, the Egyptians (as seen in their surviving wooden furniture) and the Greeks (as seen in their roof structures) are known to have possessed advanced wood joinery techniques. The Romans developed these further, building complex wooden geared water wheels, arched wooden centering for the construction of vaults and domes, and complex catapults and other machines of war. Most of these woodworking techniques were never entirely lost, surviving in Arab countries and reappearing in late Medieval Europe. Western wood joinery reached another peak in Tudor England, where it was often used in church spires and other monumental structures. Later, English emigrants to America took with them a highly advanced repertoire of joinery techniques, most of which survived there, as in Europe, until the late nineteenth century. It is interesting to note that during this entire period, the economic viability of wood joinery depended upon its low

cost relative to other means of connection—metal fasteners such as bolts, nails, and the like—which had existed since the earliest eras but were often prohibitively expensive. In the West, this situation changed rapidly with the Industrial Revolution, when both cheaply milled lumber and mass-produced nails became common. By the early twentieth century, architectural wood joinery had virtually disappeared.

Figure 89 Skill at wood joinery sets Japanese carpenters apart from others.

In Asia, the situation was somewhat different. It may be argued that even in the millennium before Christ, Chinese joinery techniques were more advanced than their Western counterparts. Although dynasties changed frequently, there was a cultural continuity in all fields in China unmatched in European culture, reaching one peak during the Han dynasty (ad 0–200) and another during the Tang (ad 600–900). The complex joinery practiced by Japanese carpenters during the building of early temples like Yakushiji represents the state of the art in early Tang China, as distilled once by contemporary Koreans and again by builders on Japanese soil. Exactly how many of the early Japanese temple builders were native Japanese is open to debate. Nishioka believed that because Hōryūji temple was based on an ancient Korean shaku scale, and Yakushiji on a Chinese scale, their master carpenters may have been Korean and Chinese respectively.

The joinery seen in Japan today thus represents the survival of an extremely archaic way of building, a kind of living time capsule. Nishioka also believed that the ancient carpenters were incomparably better than modern-day artisans, and yet, to this day, advanced joinery can be found throughout Japan. Most houses, when constructed in wood, feature traditional joints reinforced with hardware, thanks partly to newly developed computer-assisted milling machines that mass-produce jointed timber frames. Nevertheless, all agree that the days of joinery are numbered. Prefabricated housing and two-by-four construction have proven to be economical, efficient alternatives.

Many of the techniques used in temple joinery can be demonstrated in the fabrication of a basic end joint or splice, in this case the half-lapped “gooseneck” joint, one of whose

functions is to connect sections of a roof purlin (Figs. 90-177).

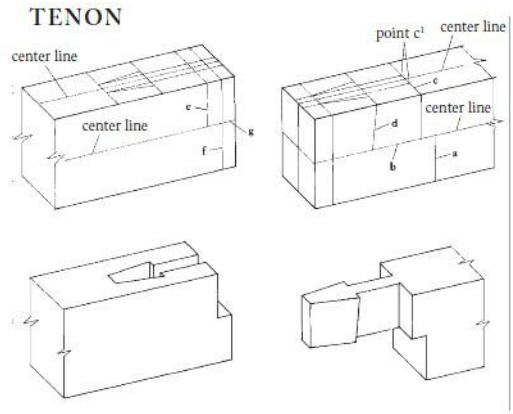
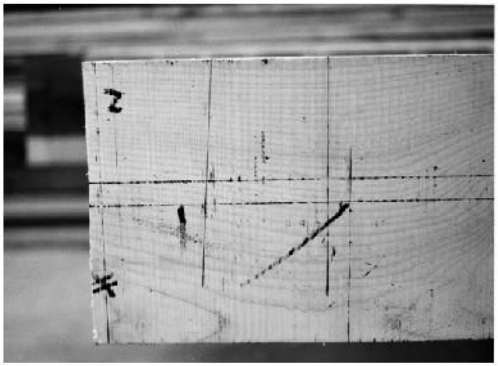


Figure 90 Half-lapped "gooseneck" splice joint. Top: Joint laid out. Bottom: Completed mortise and tenon.



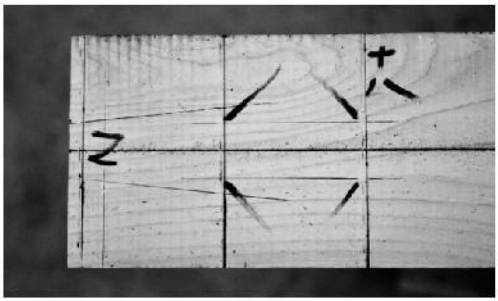
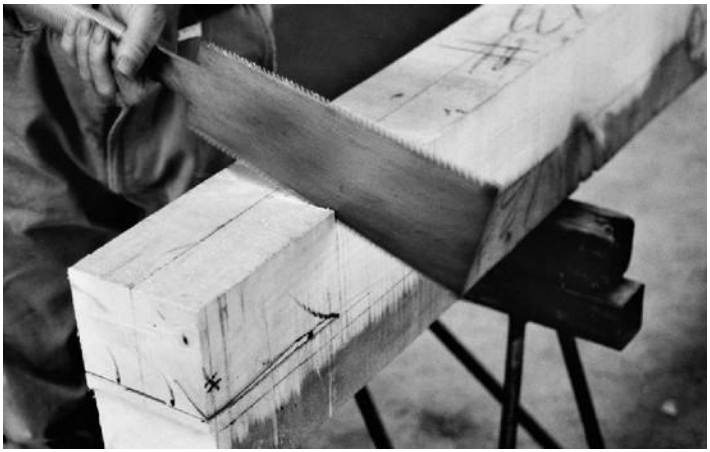


Figure 91 and Figure 92 The joint is first laid out on the end of the timber. The most important line is the center line. The other dimensions are standardized and can be quickly laid out with a steel square.



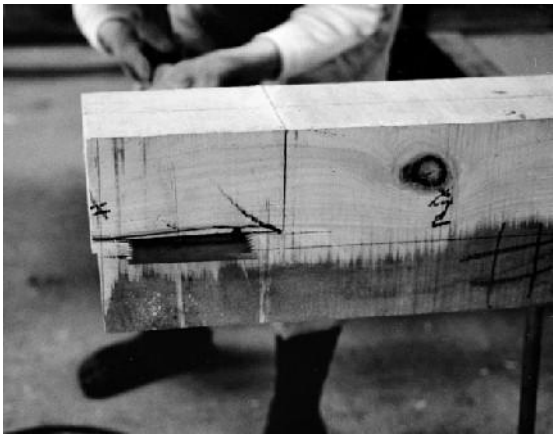


Figure 93 and Figure 94 The waste wood below the tenon is removed with a saw, first crosscutting (Fig. 92) and then ripping (Fig. 93). In both cases, the cut is taken right to line a and b (Fig. 89).

Figure 95 The waste is knocked out with a hammer, and the inner corner cleaned up with a chisel.

Figure 96 The underside of the tenon is laid out on the freshly cut surface with a steel square and bamboo marking pen.

Figure 97 The angled surfaces of the tenon are sawed, extending the line all the way to cheek line c.

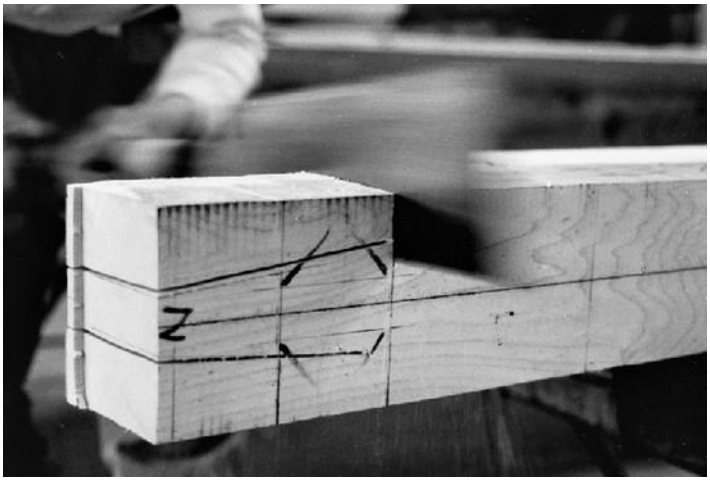


Figure 98 The cheeks are sawed all the way to the points marked c^1, and the waste removed.

Figure 99 Line d, which defines the head, is laid out. It is actually a bevel that serves to draw the joint tight as it is inserted.

Figure 100 The tip is trimmed to the line, and the bevel line d is cut. This is repeated on both sides.

Figure 101 The waste is chopped out with a chisel.

Figure 102 The surface is smoothed with a slick.

Figure 103 The finished tenon.

MORTISE

Figure 104 The mortise is aid out. (See also Fig. 89.)

Figure 105 The mortise is first drilled to remove as much waste as possible.

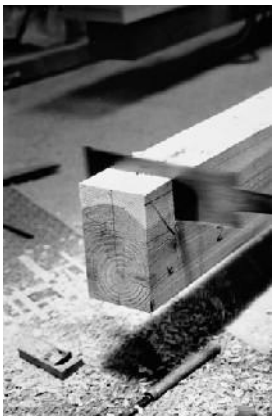


Figure 106 The lap at the end is cut with a saw, first crosscutting at lines e and f and then ripping along line g.

Figure 107 The waste is knocked out, and the inner edge trimmed with a chisel.

Figure 108 The mortise is laid out on the freshly cut vertical face.

Figure 109 The mortise sides are cut with a ripsaw as far as possible.

Figure 110 The mortise is chopped out with a chisel at an angle.

Figure 111 The mortise is chopped vertically.

Figure 112 At this point, a parallel-sided mortise is obtained.

Figure 113 The beveled line for the head of the tenon is laid out inside the mortise and then sawed.

Figure 114 The waste is chopped out with a chisel.

Figure 115 The line is then trued.

Figure 116 Lastly, the inner faces are smoothed with a slick, and the bottom surface given a slight incline to ease insertion. The surrounding edge of the opening on the upper face is also beveled slightly.

Figure 117 The finished mortise.

CHAPTER 10

ERECTION OF THE PICTURE HALL

This chapter describes the assembly and erection of the new Picture Hall in the Sanzō-in subcompound of Yakushiji temple (Figs. 33, 41). On 1 November 1985, approximately six months after the fabrication of the parts had begun, work commenced on the erection of the frame. This stage of the work—the installation of the columns, tie beams, and brace beams—took four days. The bulk of the roof structure was completed sometime before 8 December, when the ridge beam ceremony was held (see Chapter 11).

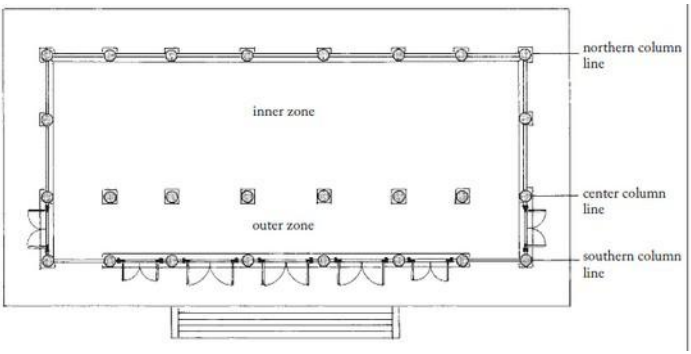


Figure 118 Plan of the Sanzō-in Picture Hall.

Figure 119 Placing a load-bearing block and cross arm on a column. (See Figs. 138, 139, 141.)

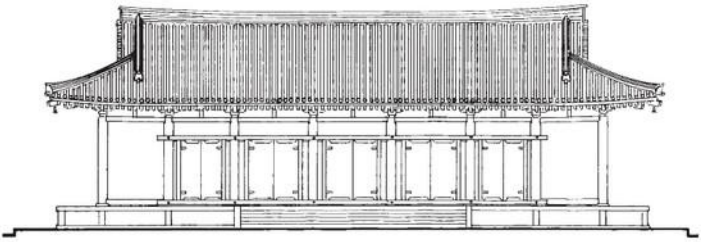


Figure 120 Southern elevation.

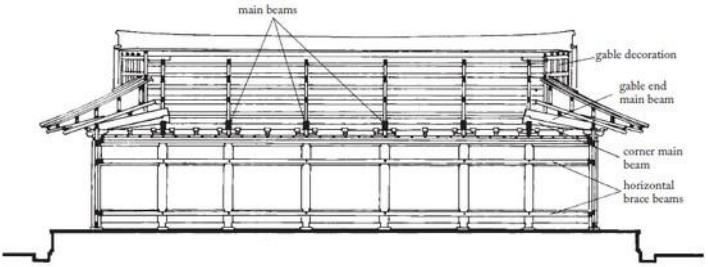


Figure 121 East–west section.

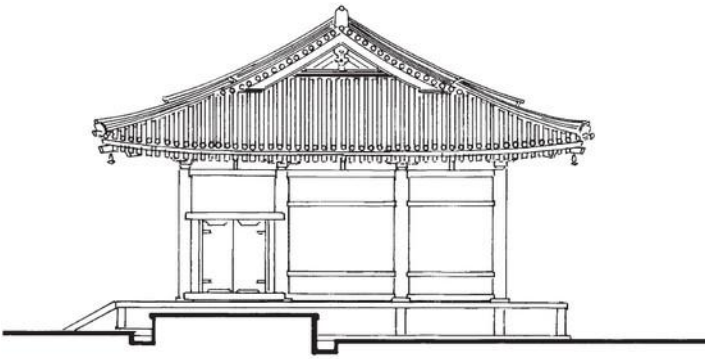


Figure 122 Eastern elevation.

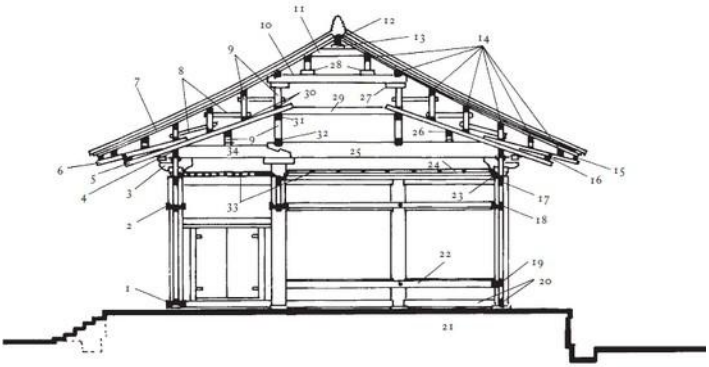


Figure 123 North–south section: 1. door sill; 2. mid-wall horizontal brace beam; 3. bracket complex; 4. wall purlin; 5. lower rafter; 6. upper rafter; 7. hidden rafters; 8. bridging; 9. stub posts; 10. mid-cross tie; 11. upper cross tie; 12. hidden ridge beam; 13. hidden ridge beam support block; 14. roof purlins; 15. eaves support; 16. upper rafter support; 17. head ties; 18. mid-wall penetrating tie beam; 19. waist tie beam; 20. base tie beam; 21. platform; 22. waist horizontal brace beam; 23. ceiling horizontal brace beam; 24. ceiling; 25. main beam; 26. outside longitudinal tie; 27. hidden support block; 28. post support block; 29. lower cross tie; 30. rafter hold-down beams; 31. upper longitudinal tie; 32. lower longitudinal tie; 33. ceiling lattice; 34. short main beam.

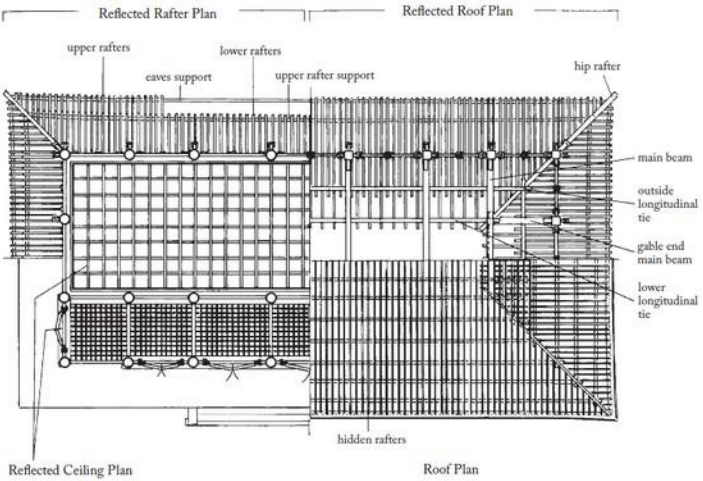


Figure 124 The reflected ceiling, rafter, and roof plans of Sanzō-in Picture Hall.

The assembly of the basic structure of the Picture Hall, including most of the roof, required only a month. Thereafter, the size of the crew was reduced and work proceeded more slowly, with the last of the roofing tiles laid in May 1986. Meanwhile, work had begun on the next building in the Sanzō-in compound, the Octagonal Hall, with only two carpenters remaining at the Picture Hall to work on the innumerable finishing details, such as the ceiling and doors. The building was essentially complete in January 1987, awaiting the interior wall paintings, tile floor, and other finishes.

During the construction of a building like the Picture Hall at Yakushiji, work proceeds simultaneously on several parts, complicating the task of documenting the various stages. The main beams may already be in place at one end of the

building, while the bracket complexes are not yet installed at the other. Meanwhile, work goes ahead on the horizontal brace beams, the door sills, and even certain sections of the wall lattice. The following step-by-step explanation is given in logical sequence as far as the construction of the Picture Hall is concerned, but it does not necessarily adhere to strict chronological order.

FOUNDATION, PLATFORM, AND BASE STONES

The foundation of the Picture Hall is a heavily reinforced concrete platform set on footings 1.5 meters deep (Figs. 125, 128). Until modern times, foundations were simple stone-walled earthen podia into which were set large stones, one under each column. Today, largely for reasons of safety, modern foundation techniques are judged superior. Fortunately, the difference is undetectable to the eye.

When the Picture Hall was complete, the rough foundation was completely faced and paved in granite quarried in Hyogo prefecture (Figs. 220-222), except for the interior, which was tiled, but at the outset only the foundation stones were set. There are twenty-six foundation stones in all, each with a protruding bronze pin that fits into a corresponding hole in the base of the column (Figs. 130, 131). The bases of the columns themselves are slightly concave (Figs. 50, 129) to lessen the possibility of water being trapped beneath them and causing rot.

COLUMNS AND PENETRATING TIE BEAMS

Twenty columns form the perimeter, and six stand inside (Fig. 118). All are tied together by penetrating tie beams at

four levels: at the base, at waist height, at mid-wall height, and at the head of the columns. The inner columns do not have base ties or waist height ties. For the perimeter columns, most of the base ties are trapped in notches at the extreme base end. Those spanning door bays are inserted a few inches above the floor, leaving a small space. Since the base ties rest directly on the foundation (Figs. 130, 131), they were laid out first and the columns then positioned above, temporarily supported by wooden blocks (all with the help of a small crane; Fig. 132). Mid-wall tie beams and door frames were inserted where necessary and secured lightly with wedges. Finally, the head tie beams were placed into slots at the uppermost ends of the columns. When a group of eight columns had been assembled, the blocks were gradually removed and the entire unit slowly lowered onto the foundation. The tie beams were more firmly wedged in, and the remaining columns and tie beams were added until the entire lower frame was complete. The erection process from the first column to the lower frame took four days.

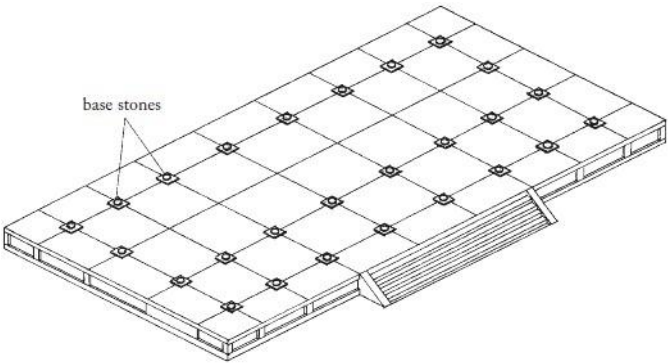


Figure 125 The Picture Hall after installation of the foundation platform and column base stones.

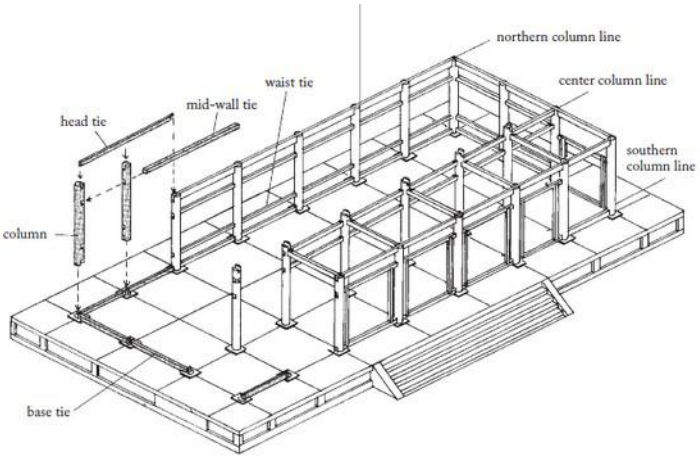


Figure 126 The Picture Hall with the lower frame nearly completed.

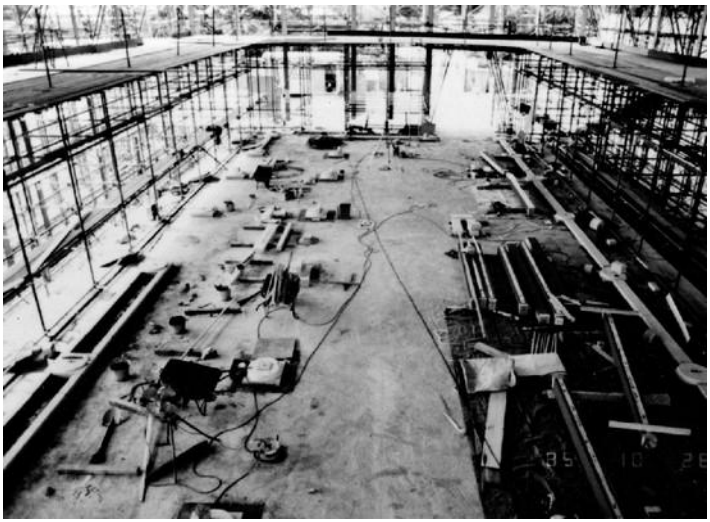


Figure 128 An overall view of the site, with the column base stones in place.

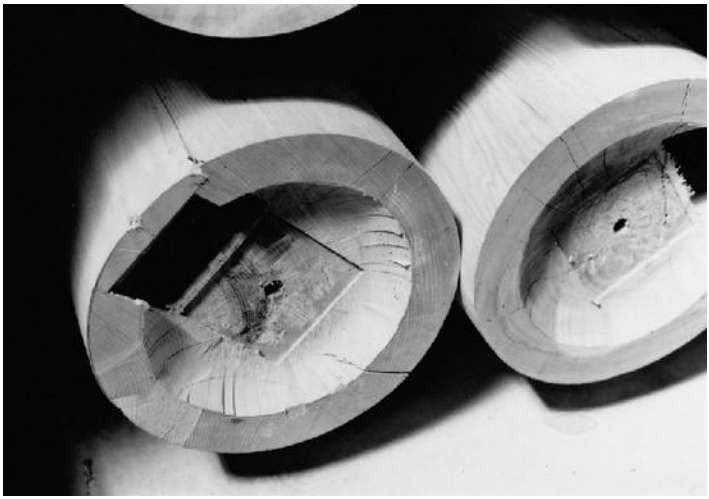


Figure 129 The bases of the columns are recessed to prevent the accumulation of water. The shallow square notch and center hole are designed to accommodate a bronze locating plate and a pin set on the foundation stone. (See also Figs. 50, 131.)

Figure 127 Masons positioning a base stone.

The uppermost tie beams, or head ties, were connected by splice joints located over the columns, taking advantage of the reinforcement provided by the surrounding slot (Figs. 133, 134). At the corners, they penetrated only partway into the column. The outer zone between the southern line of columns and the center line columns were also spanned by head ties, which required a 90 degree intersection.

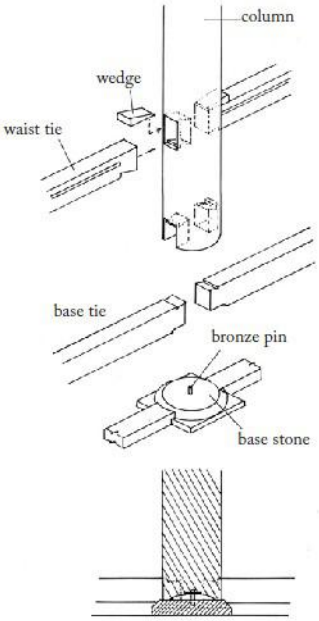


Figure 130 The configuration at the base end of a column.

Figure 131 Base tie beams resting on the base stone. The bronze locating pin for the column is visible at center.

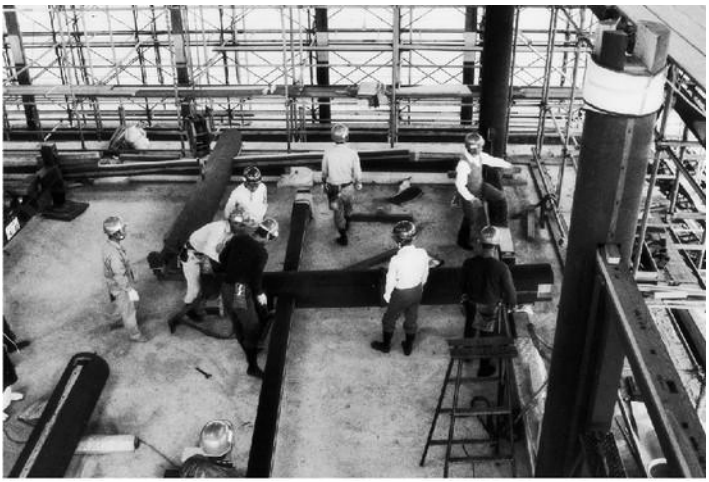


Figure 132 Mid-wall penetrating tie beams were inserted into the columns on the ground, and then raised as a section.

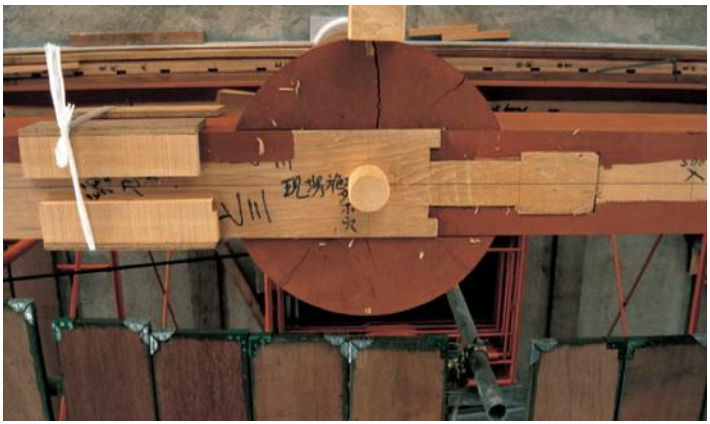


Figure 133 Square-headed “gooseneck” splices were used on head tie beams where they joined over columns.

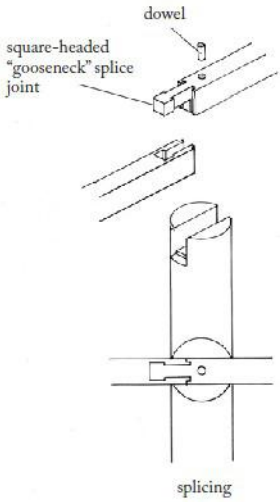


Figure 134 The relationship between head tie beams and columns.

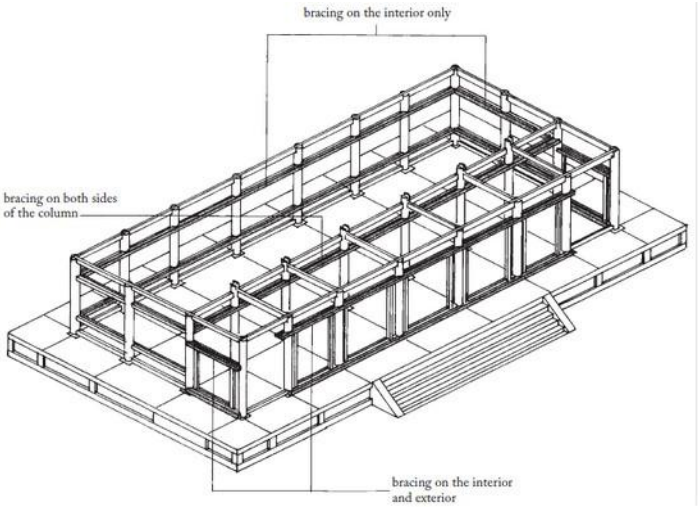


Figure 135 The Picture Hall after installment of the bracing.

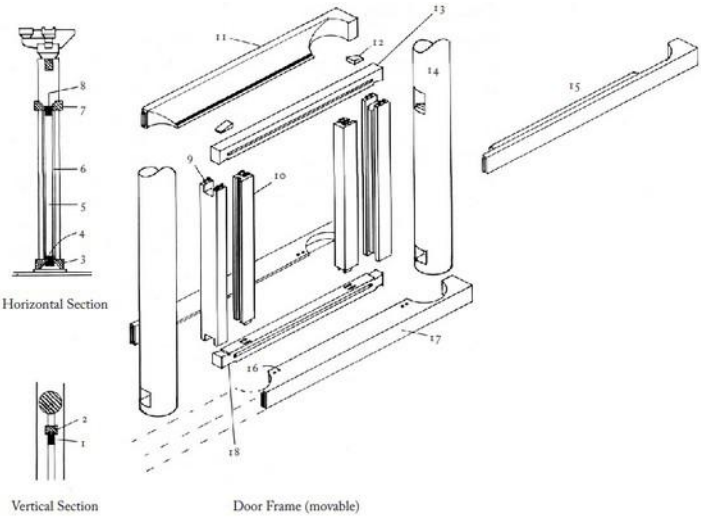


Figure 136 Door frame arrangement: 1. door post (movable); 2. door frame (movable); 3. door sill; 4. base tie; 5. door post; 6. door frame; 7. brace beam; 8. tie beam; 9. small tenons (top and bottom); 10. door post (stationary); 11. brace beam; 12. wedge; 13. tie beam (movable when wedge removed); 14. column; 15. brace beam; 16. small holes for door frame tenons; 17. door sill; 18. base tie (not movable). (See also Fig. 40.)

OUTSIDE HORIZONTAL BRACE BEAMS

Decorative horizontal braces were added above and below door openings on both the interior and the exterior, and at ceiling height, mid-wall tie height, and waist tie height on the interior (Figs. 135, 136). These braces have semicircular notches which fit around the columns. Each segment had to be fitted individually to the curves of the columns after the basic frame was erected. The brace beams are jointed and had to fit without gaps.

A special kind of brace beam was used at the bottom of the doorways (Fig. 137). As mentioned on page 71, the door sill was designed for easy replacement.

Figure 137 A door sill being installed.

BRACKET COMPLEXES

One bracket complex is located above each of the perimeter columns (Fig. 138). Altogether, there are fourteen regular, four corner, and two special bracket complexes (these last two are discussed in the next section). For each regular bracket complex (Figs. 139, 140), a large block was first fixed atop the column by means of a round dowel inserted into the head tie (Fig. 144). Next, a cross arm was added (Fig. 119), and then a center bracket arm, which rested on both the large block and the cross arm. Finally, two small blocks were placed atop the cross arm, situated on round pegs, to complete the bracket (Fig. 185).

The corner bracket sets were similar (Figs. 140, 142, 146), except that a tenon replaced the dowel and two cross arms were placed on top of the large block (Fig. 146). The center bracket arm was shaped to fit over the cross arms, ultimately nestling among four small blocks fixed by dowels to the two cross arms (Fig. 147). Short block-bearing struts were then put in place between each bracket complex (Fig. 130).

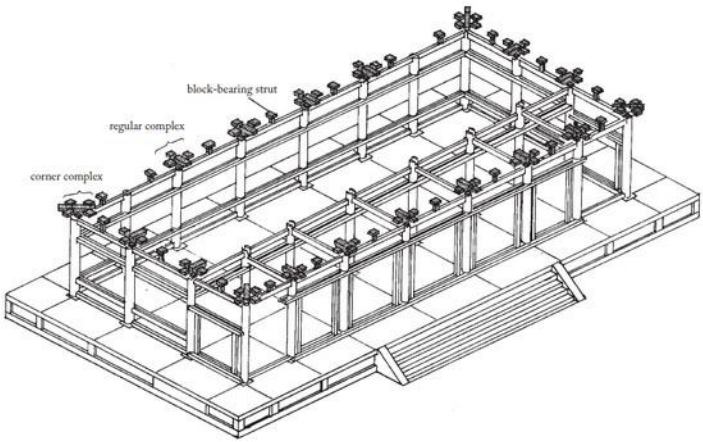


Figure 138 The Picture Hall after installation of the bracket complexes to support the roof load.

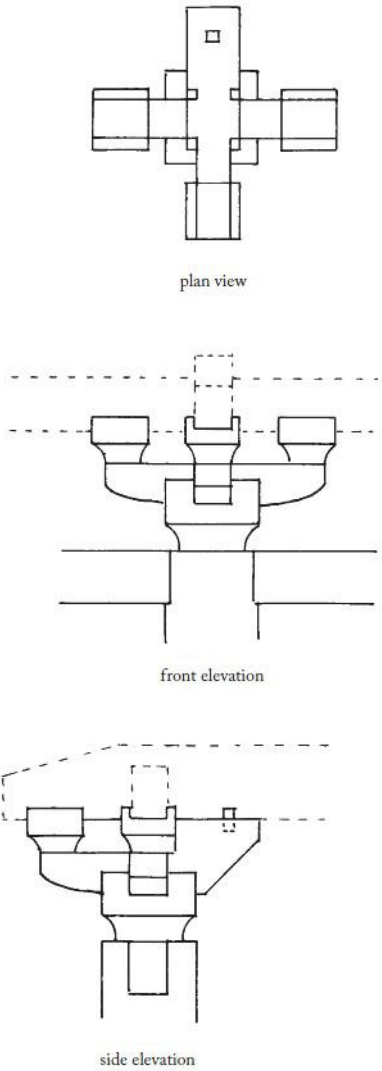
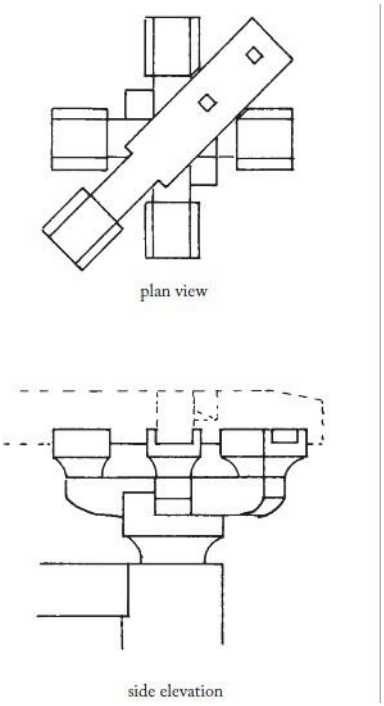


Figure 139 A regular bracket complex.



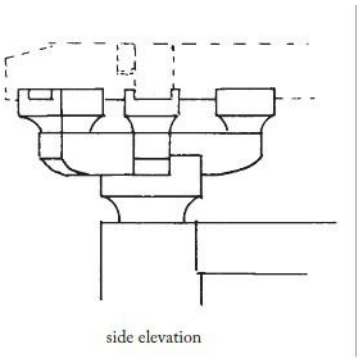


Figure 140 A corner bracket complex.

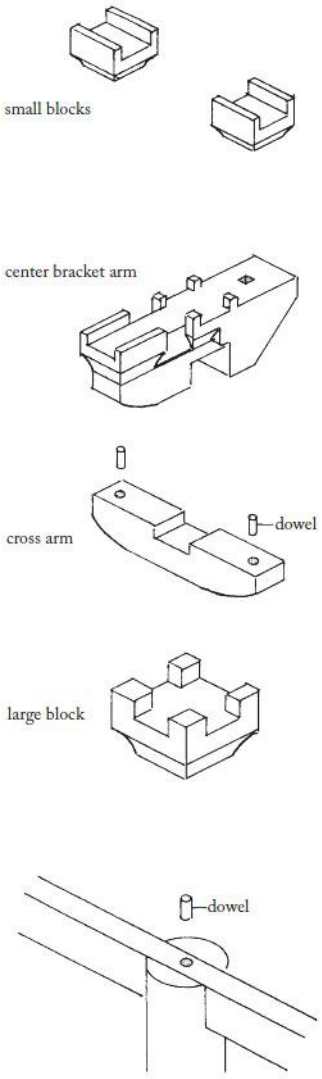


Figure 141 A regular bracket complex assembly.

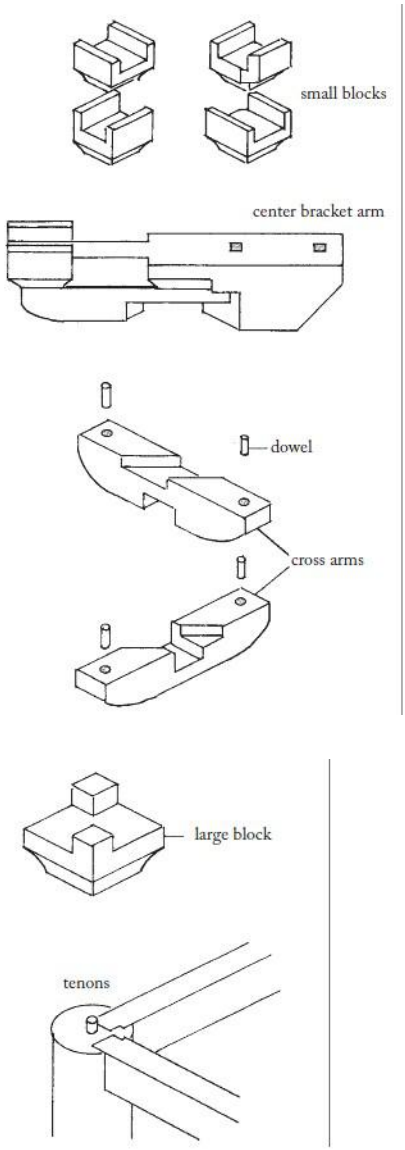


Figure 142 A corner bracket complex assembly.

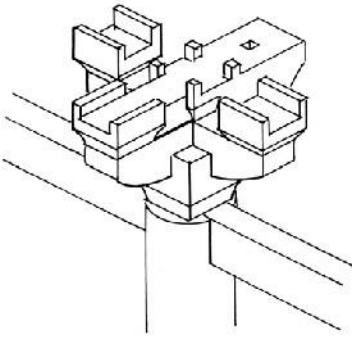


Figure 143 A completed regular bracket complex.

Figure 144 A large block is located by means of a dowel inserted into the head tie beam over the center line of the column.

Figure 145 The center cross arm of a regular bracket complex fits over a smaller cross arm, both firmly supported by the large block.

Figure 146 Installing the cross arms of a corner bracket complex.

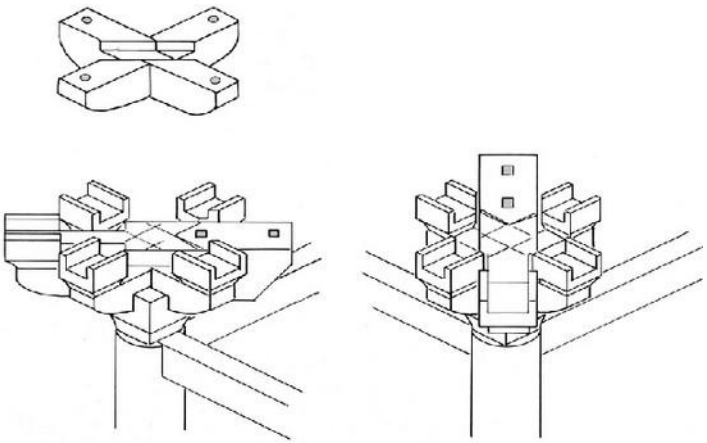


Figure 147 and Figure 148 A completed corner bracket complex.

BRACKET BEAMS

For reinforcement at the gable ends, two long beams with a bracket complex at one end span the center column line (Figs. 149, 152). At the bracket end (Figs. 150, 151), a projection penetrates a specially shaped large block and rests directly on top of the column. Together with the cross arm, this projection locks the beam in place (Fig. 153).

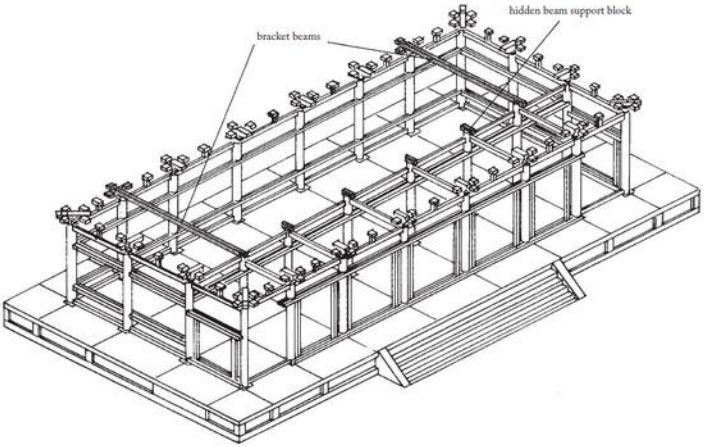


Figure 149 The Picture Hall after installation of the bracket beams.

Figure 150 The bracket beam has a projection that rests directly on the column and head tie beam, snaring the dowel with a modified large block.

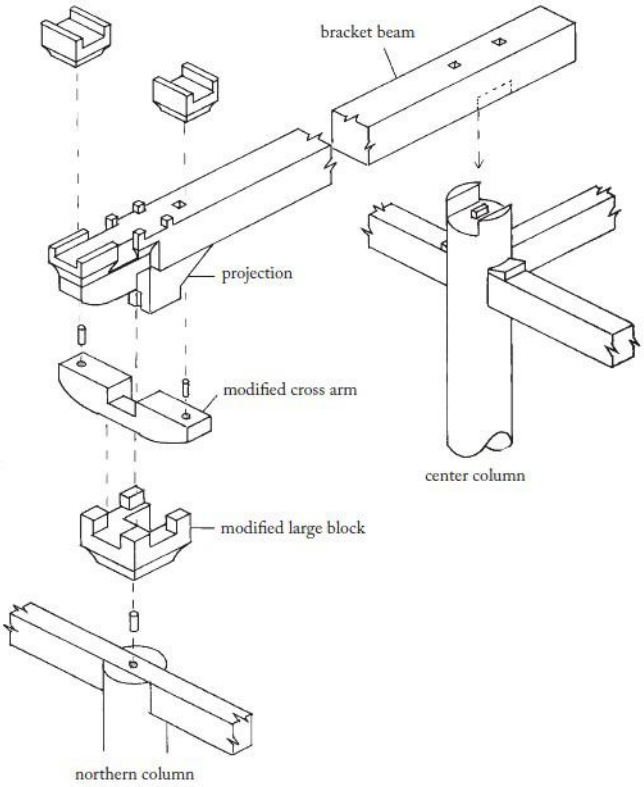


Fig. 151 The bracket end of a bracket beam.

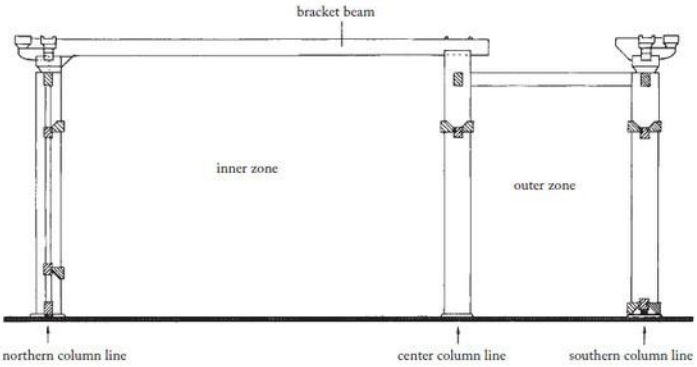


Figure 152 Sectional view of a bracket beam.

Figure 153 The modified large block and cross arm were designed to be inserted after the bracket beam had been put in place.

WALL PURLINS

The wall purlins tie the entire structure together at this level, resting atop bracket complexes and block-bearing struts (Fig. 154). Together with the penetrating ties and head ties, they define the wall plane (Fig. 123). The wall purlins are jointed into three sections on the long sides and two on the short, with the joints falling above the bracket complexes and the columns (Figs. 155, 160). The joints are designed to provide a smooth bearing surface for the members that will rest on them, and to resist both tension and torsion. The wall purlins overlap at the corners (Figs. 156, 159). Here we can begin to see the roof curve develop. As mentioned on page 70, while the head tie beams are perfectly horizontal, the wall purlins slope upward at the ends, supported by differences in height of the bracket sets and blocks.

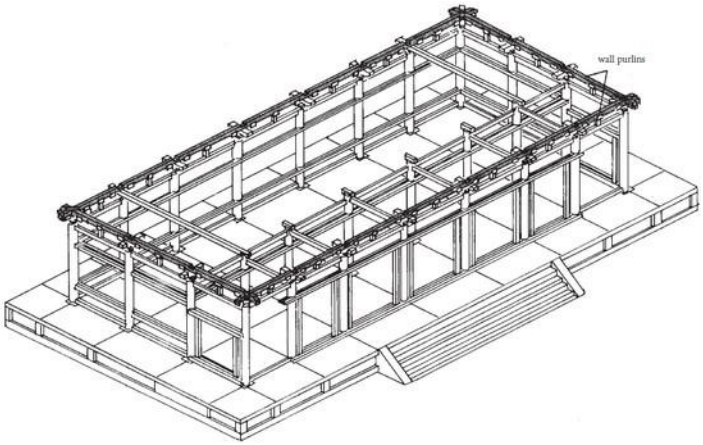


Figure 154 The Picture Hall after installation of the wall purlins.

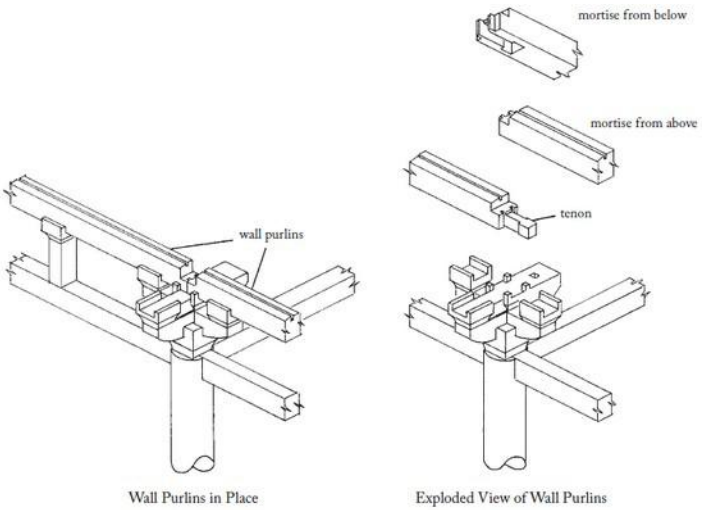


Figure 155 Wall purlins are spliced over the column and bracket sets with a variant of the “gooseneck” joint, leaving a recess and smooth surface on top to receive members above.

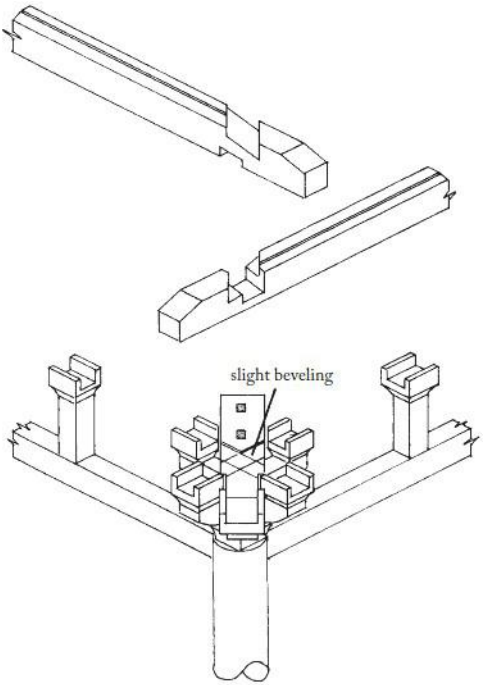


Figure 156 Wall purlins are joined at the corners with a simple cross-lap joint so as to accommodate the slope of the purlins as well as that of the members to be installed above.

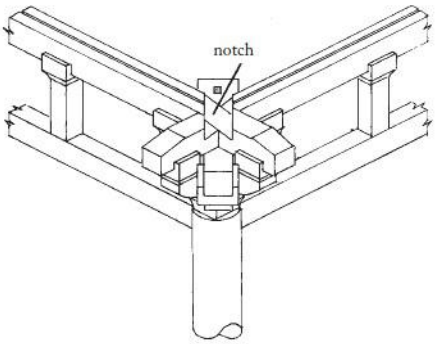


Figure 157 The overlapping of wall purlins at a corner. Note the notch to receive the upper hip rafter.

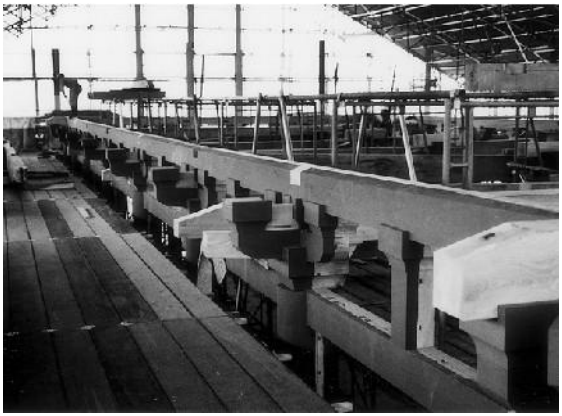


Figure 158 The slight upward sweep of the wall purlins at the ends is perceptible in this photograph.

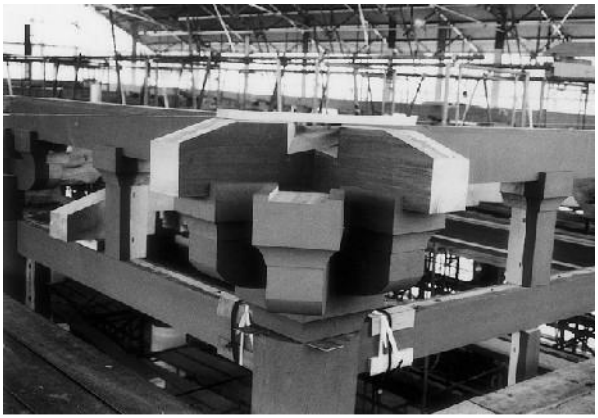


Figure 160 The modified “gooseneck” splice of wall purlins over a bracket complex.

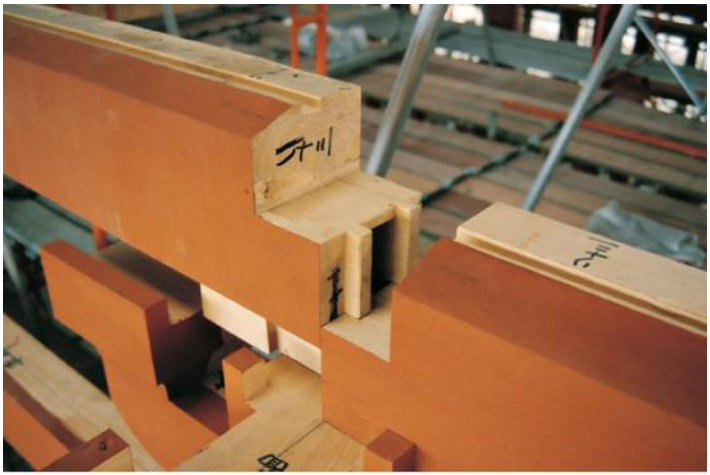


Figure 159 Wall purlins overlapping at the corner.

MAIN BEAMS

The next layer of the structure is composed of heavy main beams which span the structure crosswise, bearing most of the roof load (Figs. 161, 166). These beams are in two sections of different length, which join above the inner columns.

The shorter beams were installed first, with the help of a chain hoist. One end lay atop the block on an inner column, and the other end straddled the wall purlin situated as described earlier, resting on the bracket complex center arm (Figs. 162, 163, 165).

The longer beams were similarly installed, joined to the shorter ones with a zigzag splice joint (Fig. 164).

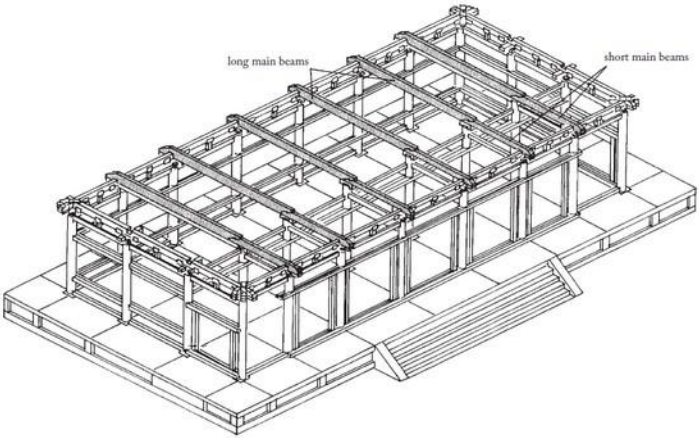


Figure 161 The Picture Hall after installation of the main beams.

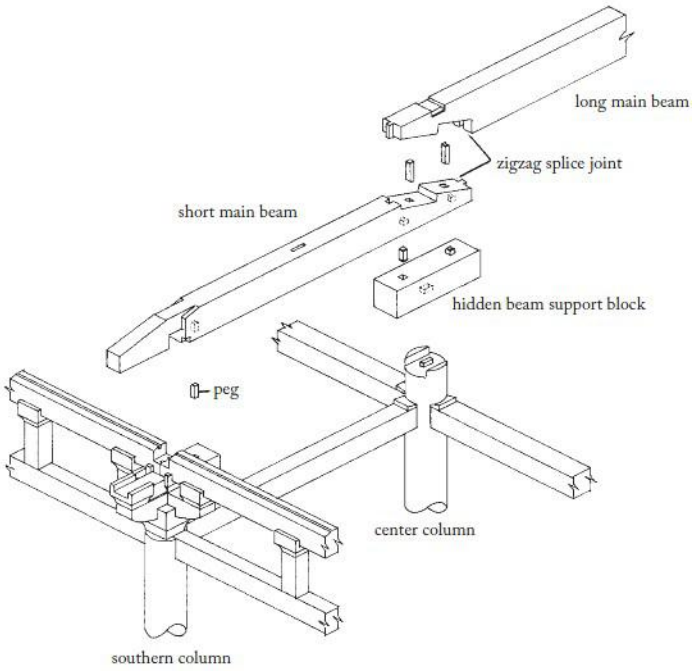


Figure 162 The main beam assembly.

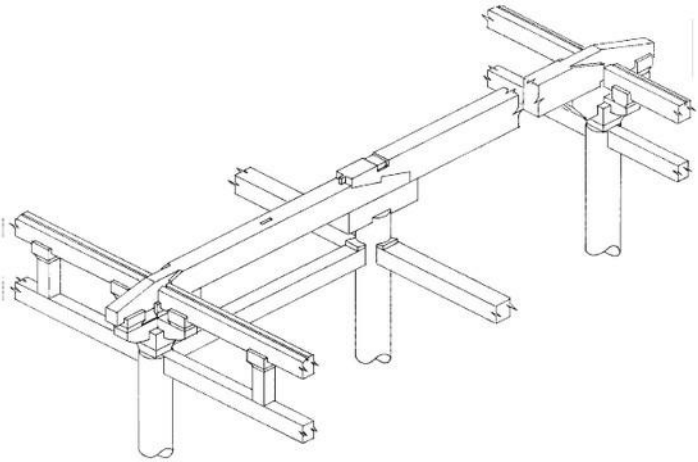


Figure 163 The completed assembly of the main beam.

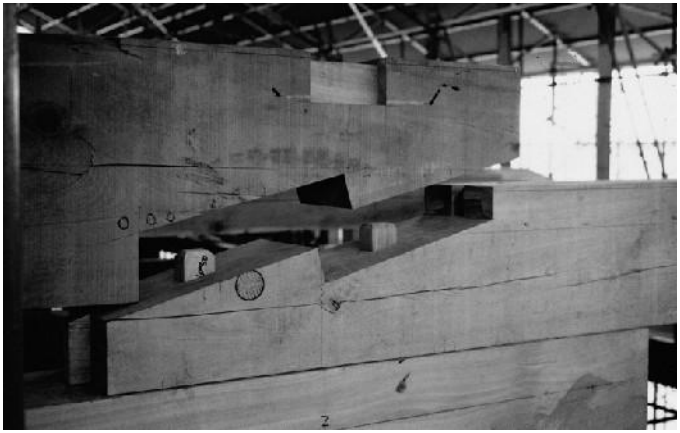


Figure 164 A zigzag splice joint.

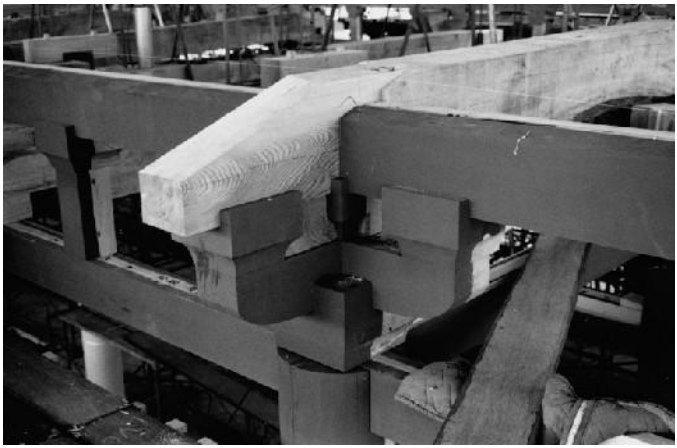


Figure 165 The long main beams fit over the wall purlins and are supported by the center arms of the bracket complexes. Thus, they lock the entire structure together crosswise at this level.

Figure 166 An overview showing the main beams in place.

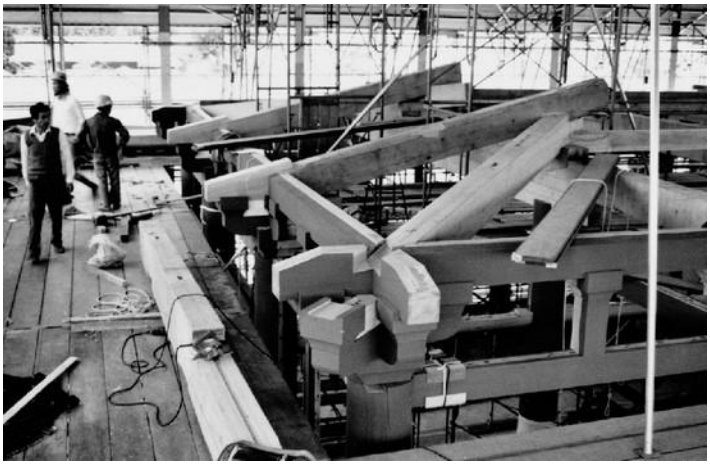


Figure 167 The corner main beams span at a slope from the nearest main beam to the corner bracket complex. The gable end main beams rest directly on the corner main beams and span to the exterior wall.

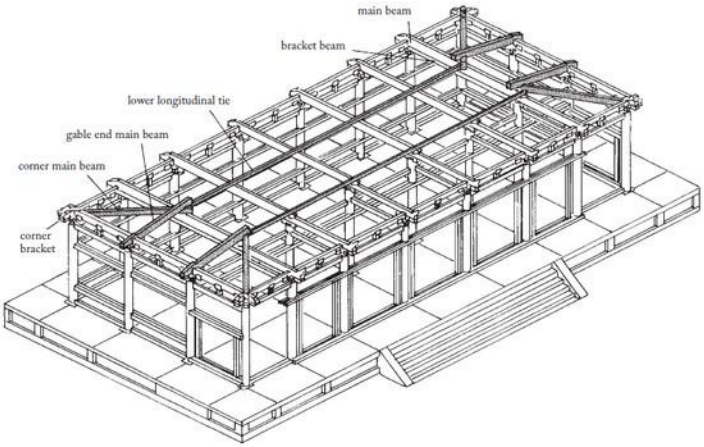


Figure 168 The Picture Hall after installation of the corner main beams, the gable end main beams, and the lower longitudinal ties.

CORNER MAIN BEAMS, GABLE END MAIN BEAMS, AND LOWER LONGITUDINAL TIES

Near the ends of the building, the long main beam rests directly on the long bracket beam, in effect becoming one extremely deep compound beam (Fig. 168). This is necessary because the weight of the entire roof at the gable end will eventually come to bear here, transmitted through the corner main beams and the gable end main beams.

Before the corner and gable end beams could be installed, however, the other main beams had to be tied together by means of long tie beams (lower longitudinal ties), which run almost the length of the structure. Like the head ties, these longitudinal ties are composed of jointed segments (Fig. 171) and sit in shallow notches on the upper sides of the main

beams. They have mortises for short posts, which were added later.

The gable ends require a corner main beam, which spans from the corner bracket set to the doubled-up main beam nearby, sloping downward (Fig. 167). On top of it was placed the gable end main beam, which slopes even more steeply, spanning to a bracket set (Fig. 169). The result is a pile-up of structural members above the main beams, creating a giant knot of timber.

Figure 169 Like the other main beams, the gable end main beam was installed over the wall purlin and bracket complex. The carpenter at left has one foot resting on part of the bracket complex.

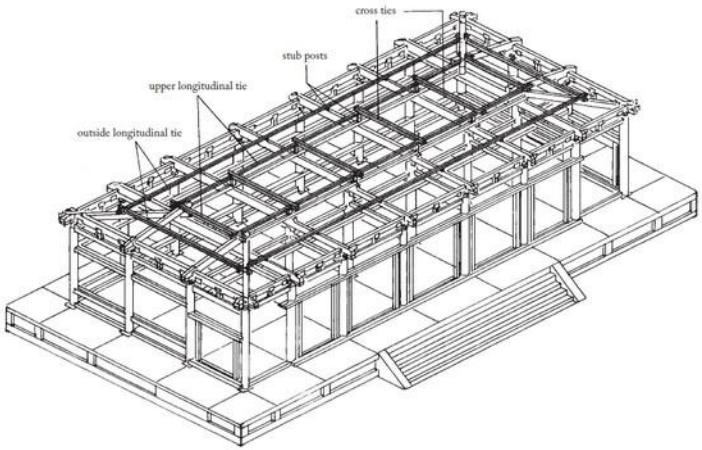


Figure 170 The Picture Hall after installation of the stub posts, outside and upper longitudinal ties, and cross ties.

STUB POSTS, OU TSIDE AND UPPER LONGITUDINAL TIES, AND CROSS TIES

Two more sets of longitudinal ties (the outside and upper) were installed here, supported on stub posts (Figs. 170, 174). They were then connected crosswise by cross ties. These ties were also connected at the gable ends. The structure above an inner column at this point is as shown in Fig. 173.

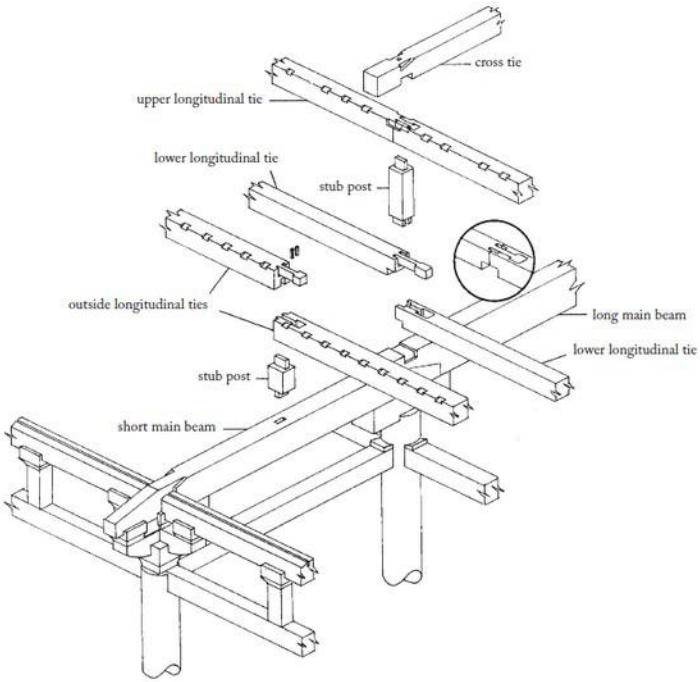


Figure 171 Assembly of the stub posts, longitudinal ties, and cross ties.

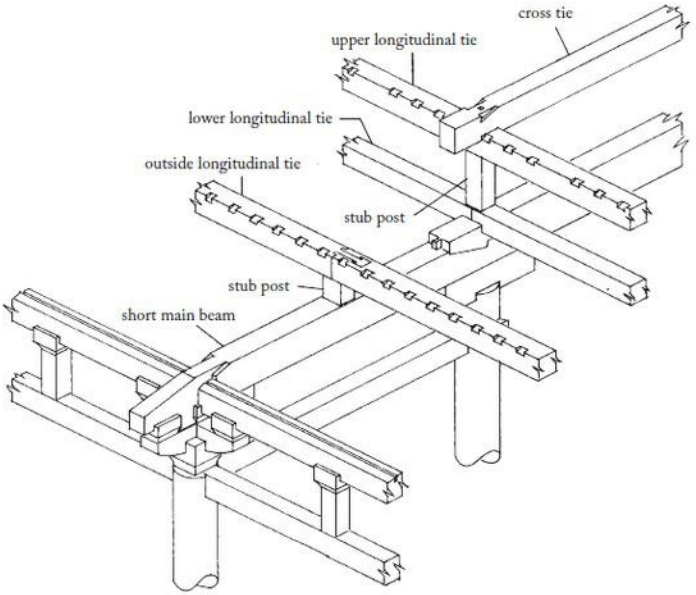


Figure 172 The completed assembly of the stub posts, longitudinal ties, and cross ties.

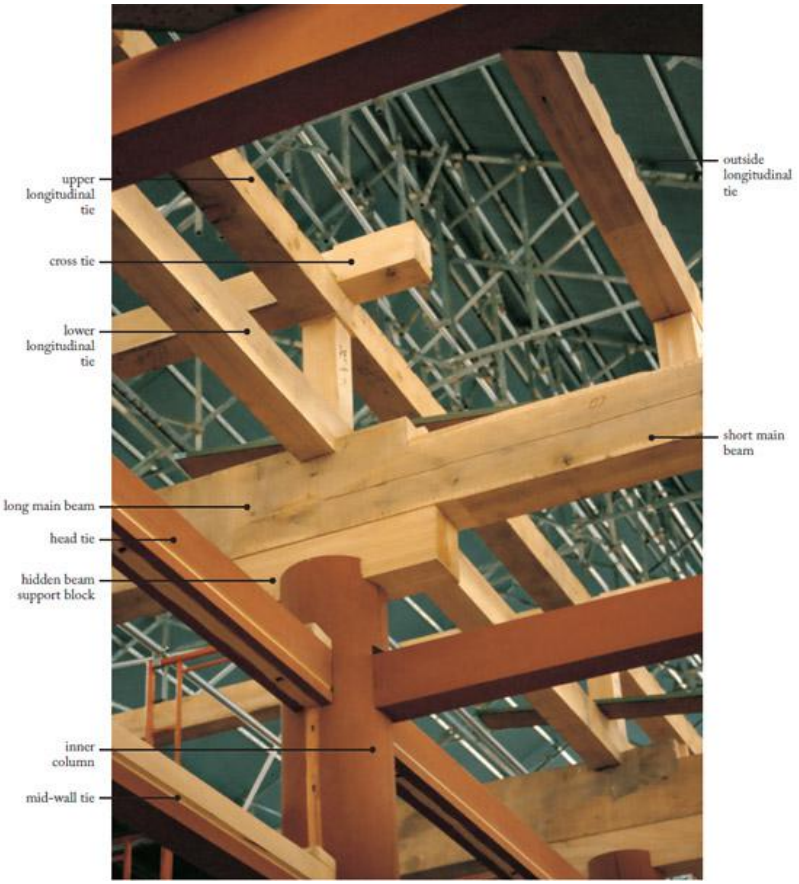


Figure 173 The structure above a typical inner column.

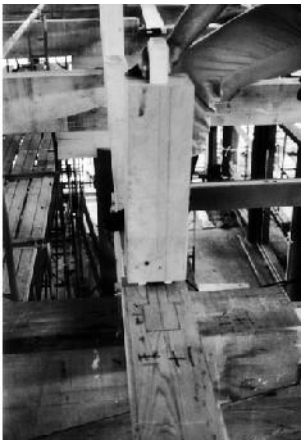


Figure 174 This stub post is located over a “gooseneck” splice joint in the longitudinal tie. Double tenons were used to straddle the “gooseneck” tenon below.

HIP RAFTERS

Hip rafters are composed of two parts, a lower (or “base”) part and an upper (or “flying”) part. They cantilever outward beyond the wall line almost a third of their length and bear a significant portion of the overhanging roof load (Fig. 175). The lower hip rafter fits into slots at three points: where the outside and upper longitudinal ties overlap, on the corner main beam, and where the wall purlin and the corner bracket set come together (Figs. 176, 167). Hip rafters are shaped so as to lock these several layers of structure together while being supported by them.

The lower hip rafters required painstaking installation as the ends of all four had to lie exactly level to each other. Any discrepancies among the numerous supporting members had

to be resolved at this stage through careful trimming and adjustment, complicated by their great weight (Figs. 179, 181). Once the lower hip rafter was in position, the upper portion could be simply installed, kept in place by a long groove and two rectangular pegs (Figs. 182, 183). The parts were eventually permanently jointed by large U-shaped wrought-iron clamping pins, but were left unconnected throughout the fitting of the rafters and rafter supports described in the next section.

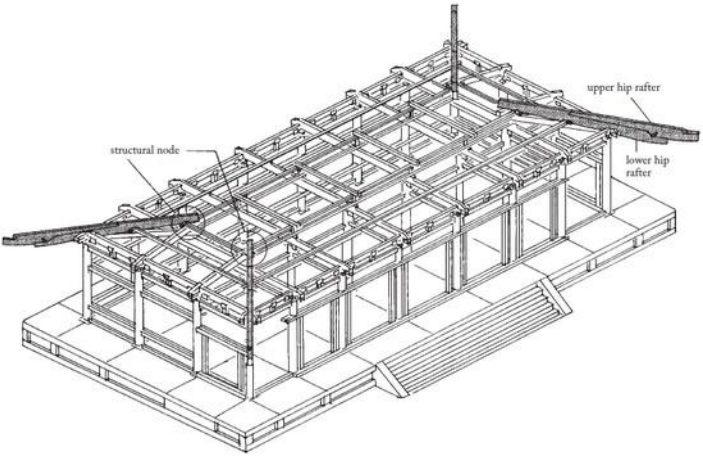


Figure 175 The Picture Hall after installation of the hip rafters.

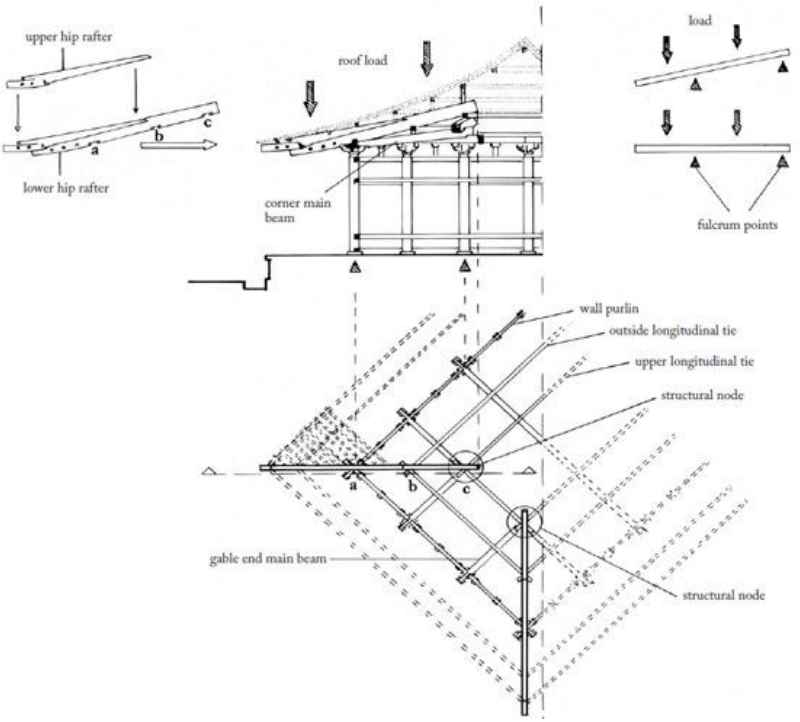


Figure 176 Hip rafter function. A hip rafter is notched onto a wall purlin at a, onto the outside longitudinal tie at b, and onto the upper longitudinal tie at c.

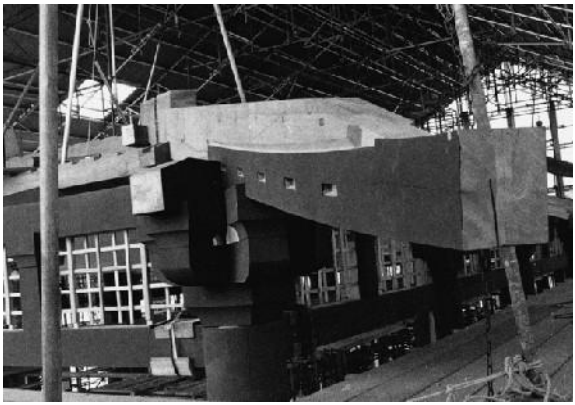


Figure 177 This lower hip rafter extends past a corner bracket complex.

Figure 178 The upper hip rafter as it was installed.

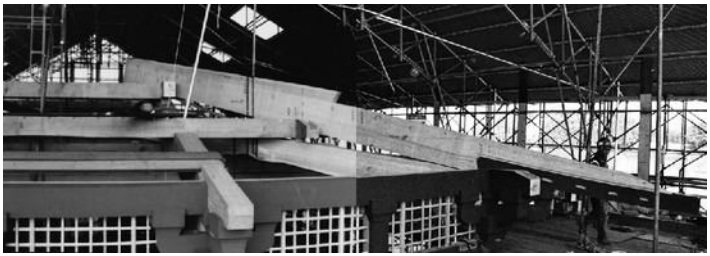


Figure 179 A lower hip rafter.

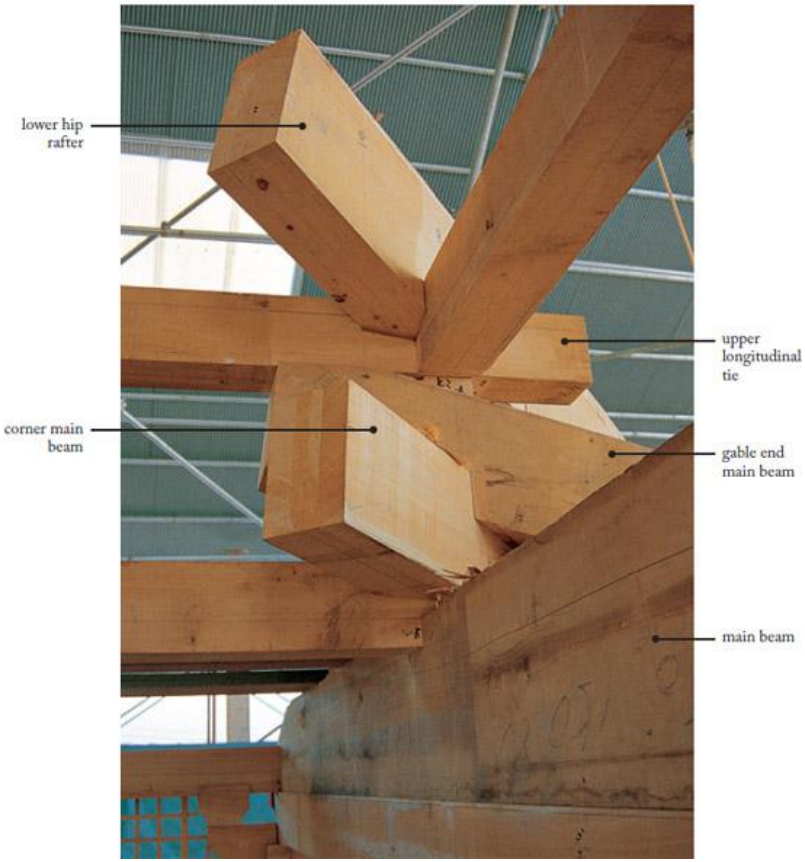


Figure 180 The structural node where the beams and hip rafter meet.

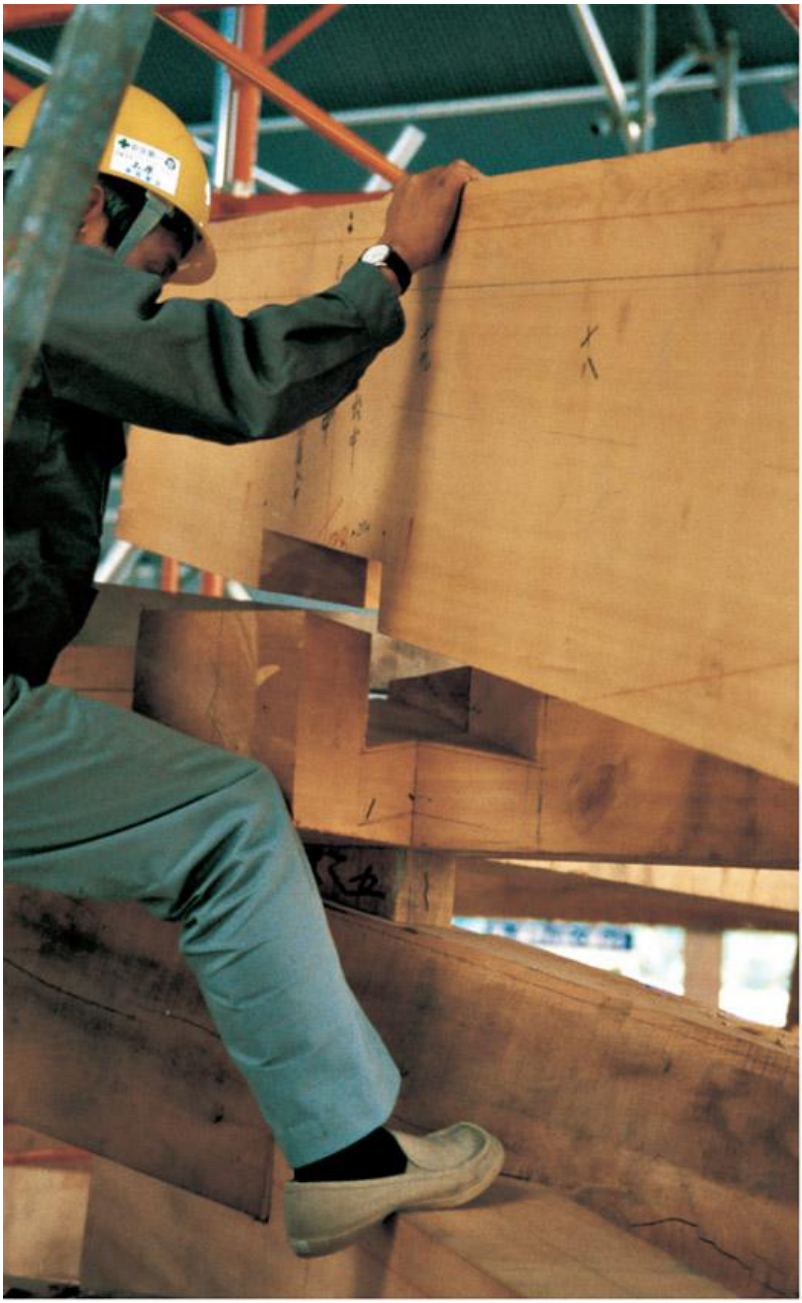


Figure 181 The fit of a lower hip rafter is repeatedly tested and trimmed if necessary.

Figure 182 The upper hip rafter will be mated to the lower hip rafter by means of square pegs and a long tongue-and-groove. (See also Fig. 183.)

LOWER RAF TERS AND UPPER RAF TER SUPPORTS

The lower rafters lie across the outside and upper longitudinal ties and the wall purlins (Fig. 187). Like the hip rafters, they cantilever out about two meters. The lower rafters nestle into toothlike slots on the longitudinal ties and into toothed boards set into a slot in the wall purlins. At their extreme ends, they support a toothed beam which, in turn, supports the upper rafters (Figs. 185, 186). This beam, or upper rafter support, is made in sections. The rafters which support the joints were the first to be installed, their heights adjusted until the support beam was perfectly curved. (The upper rafter supports are curved in both plan and elevation, that is, they twist upward and outward as they approach their intersection with the hip rafters; page 70). Once the proper curve was established, the remaining lower rafters were installed and sandwiched into place at their upper ends by a hold-down beam. The rafters at the corner intersect with and are connected to the hip rafters, and so are shorter than the rest. Other rafters run alongside the main beams, and come in contact with the bracket sets. The rafters were then secured in place with large wrought-iron spikes.

Figure 183 Upper hip rafters upside down, each showing the long tongue which fits into a corresponding groove in the lower hip rafter. (See Fig. 182.)

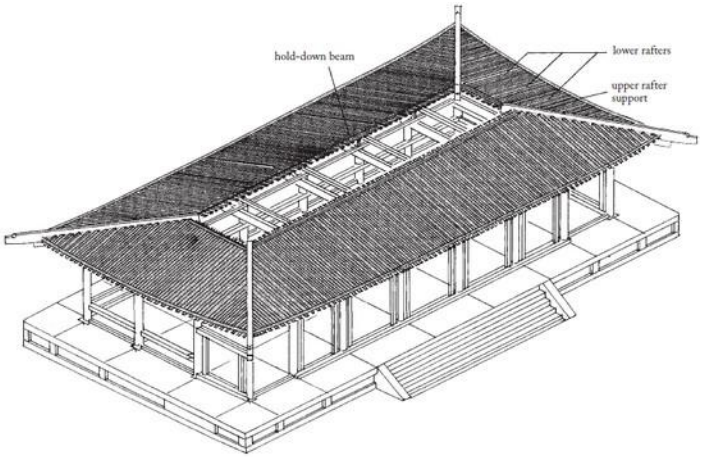


Figure 184 The Picture Hall after installation of the lower rafters and upper rafter supports.

Figure 185 The upper rafter supports are themselves supported at the ends by the hip rafters. Their curve is very pronounced in both plan and section. (See also Fig. 67.)

Figure 186 The toothed upper rafter support is attached to the lower rafters by means of wrought-iron spikes.

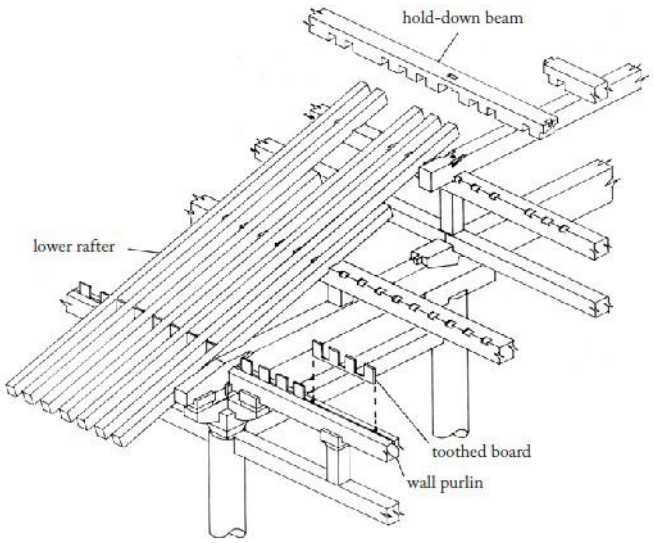


Figure 187 Assembly of the lower rafters and upper rafter supports.

UPPER RAF TERS AND EAVES SUPPORTS

Before the upper rafters could be installed (Fig. 188), a layer of backing boards had to be placed over the lower rafters (Fig. 189). These were painted white on the underside and spanned the gaps between the rafters, one board for each opening. They were positioned so as to allow for expansion. The upper rafters were then inserted into the toothed slots in the upper rafter support, with their other tapered ends resting on the lower rafter backing boards. The upper rafters supported a curved beam similar to the upper rafter support called the eaves support (Fig. 190). The eaves support fills the gap between the upper rafters and the roofing tiles, and receives the lower ends of another layer of sheathing. A special joint was used to connect its segments. This beam was installed similarly to the upper rafter support, that is, with the jointed areas being supported and adjusted first. With the installation of the remaining rafters, the exposed underside portion of the roof was complete.

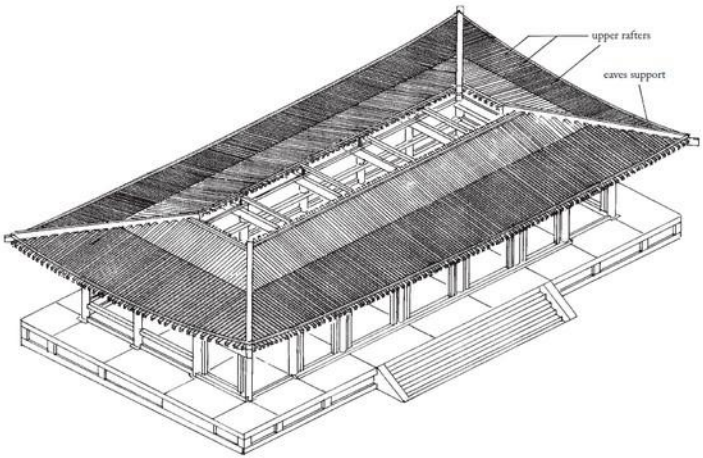


Figure 188 The Picture Hall after installation of the upper rafters and eaves supports.

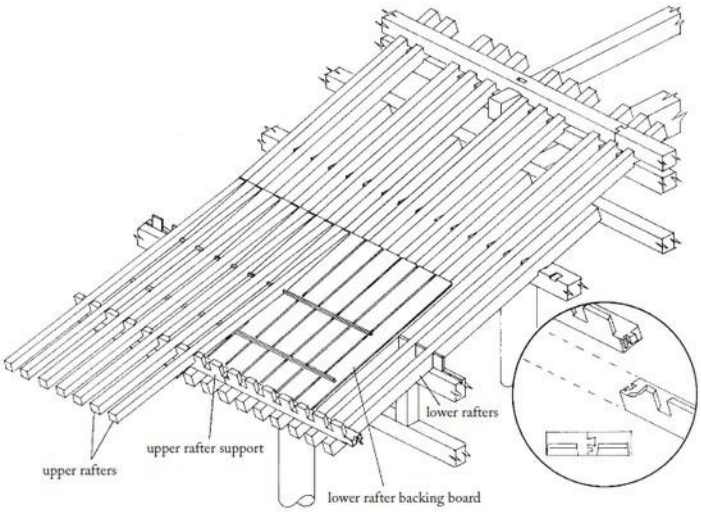


Figure 189 Assembly of the upper rafters and eaves supports. The inset shows a dovetail splice joint on an upper rafter support.

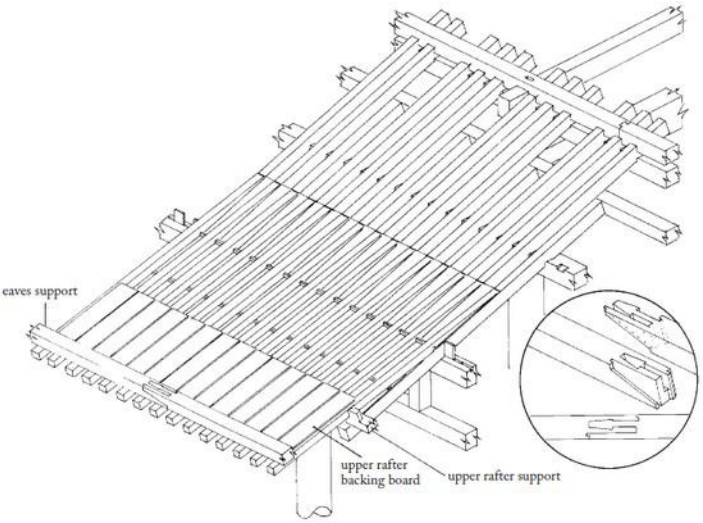


Figure 190 Assembly of the upper rafter backing boards and eaves support. The inset shows a splice joint on an eaves support.

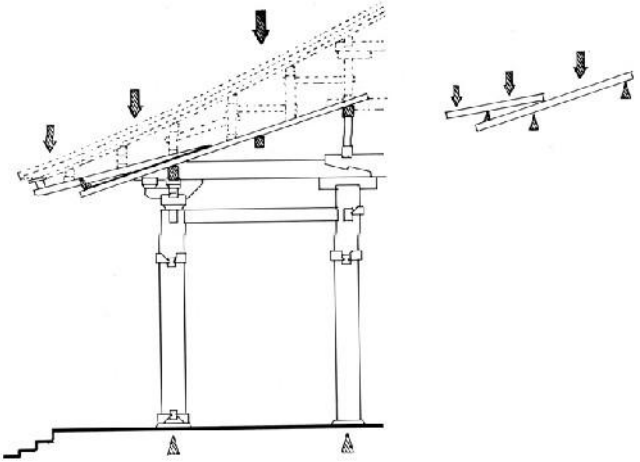


Figure 191 The cantilever action of the rafters.

Figure 192 The upper rafters in relation to the upper rafter support and eaves support.

Figure 193 The eaves support.

HIDDEN ROOF STRUTS AND BEAMS

One design feature that separates Japanese temples from their continental prototypes is the use of an illusion in the roof area. The rafters that are exposed at the eaves are not the "real" rafters in that they do not directly support the roof surface. The slope of the actual roof is steeper than indicated by the members exposed at the eaves. Thus, Japanese temples are said to have a "hidden" roof. In effect, a hollow space is formed between the gently sloping exposed rafters and the steeply sloping hidden rafters. This hollow space is filled with stub posts and roof purlins, and numerous small braces, or bridging (Fig. 194). The actual rafters rest atop the purlins and are entirely hidden from view.

To install the hidden rafters, stub posts were first inserted into mortises in the rafter hold-down beams, of which there were six sets in all (Fig. 195). These stub posts increase in height as they approach the roof ridge, and all of them have slots for bridging. Near the top of the roof, another set of cross ties was installed, resting on blocks set atop the stub posts (Fig. 196). Two more sets of posts were inserted into the cross ties, followed by two more roof purlins. This was followed by the installation of another set of cross ties, and finally the blocks which support the hidden ridge beam itself. In addition, the decorative purlins, which were to be left exposed at the gables, were installed (Figs. 199, 200).

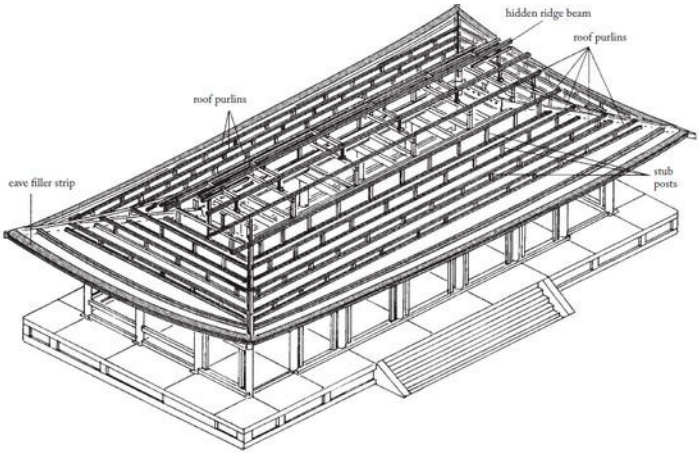


Figure 194 The Picture Hall after installation of hidden roof structure (rafters and bridging omitted for clarity).

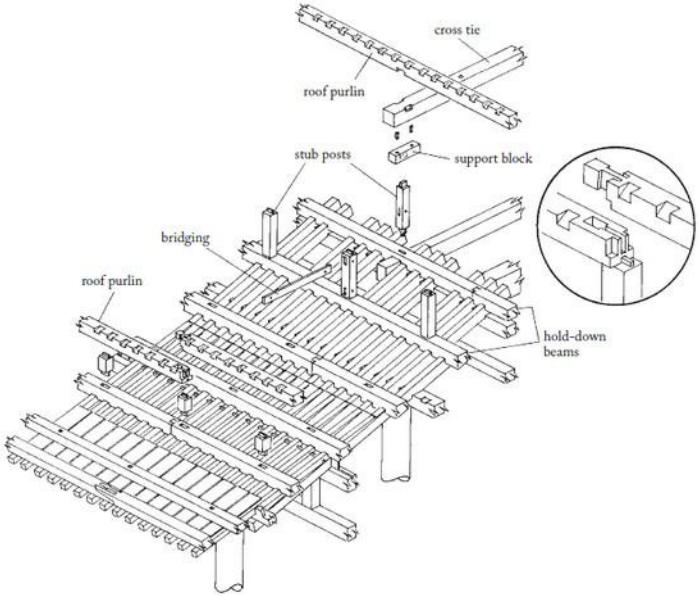


Figure 195 Parts of the hidden roof structure. The inset shows a square-headed “gooseneck” splice in the roof purlin.

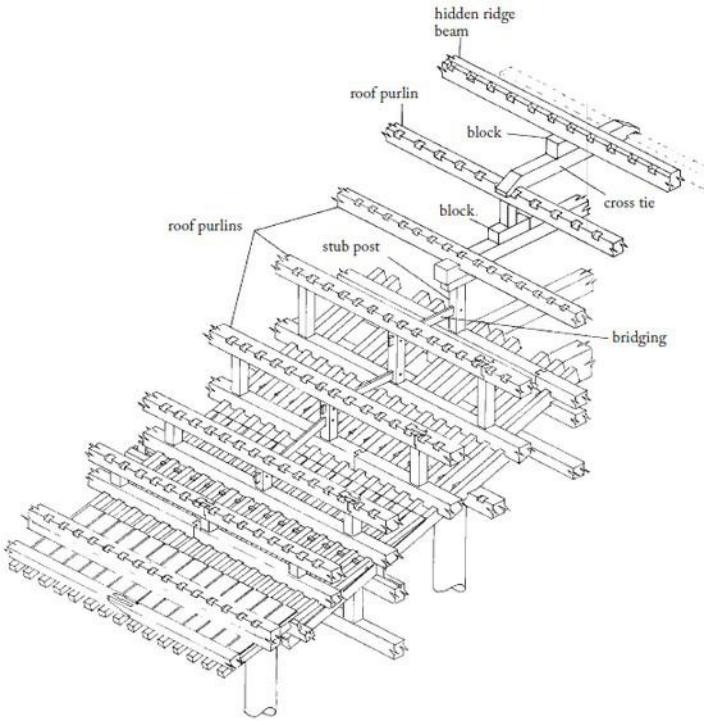


Figure 196 The hidden roof members and the ridge beam in place.

Figure 197 The uppermost roof purlins and stub posts are installed.

Figure 198 The mid-cross ties are carried on short blocks on top of the uppermost stub posts.

Figure 199 The hidden ridge beam is uppermost. Below it are the short decorative beams that will be visible at the gable.

Figure 200 The hidden ridge beam, with the decorative ridge beam below it.

FINISHING THE ROOF STRUCTURE

The hidden rafters now had to be installed above the roof purlins (Figs. 201-204). They are noticeably smaller in section than the exposed rafters and had to be bent to

accommodate the roof curve. Roofing boards (sheathing) were then laid above the hidden rafters. The gables, which would be left exposed, were completed by the addition of fascia boards, a decorative set of cross beams, struts, and diagonal braces (Fig. 205), rafters, and a decorative pendant.

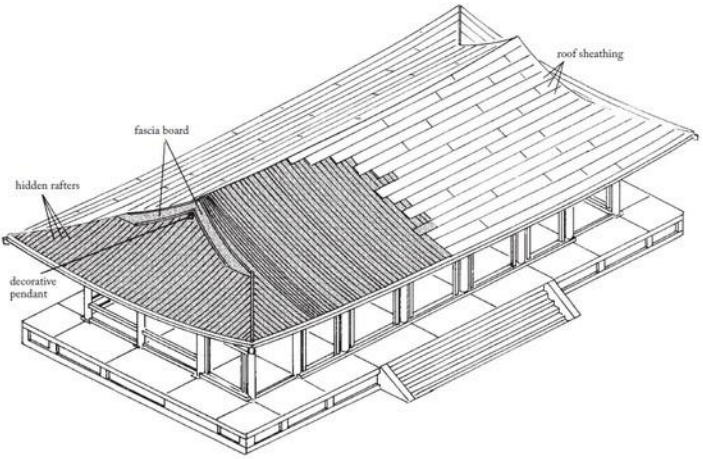


Figure 201 The Picture Hall after the installation of the hidden rafters and sheathing.

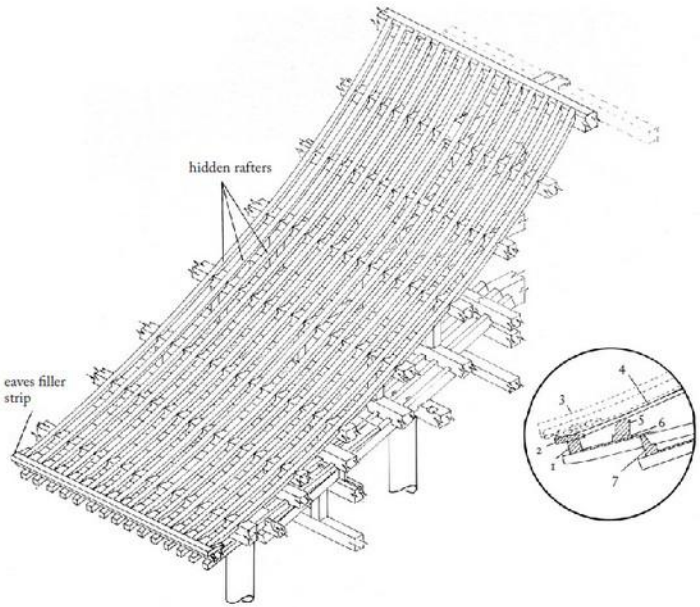


Figure 202 The completed hidden rafter structure. The inset shows a detail of the edge of the eaves: 1. eaves support; 2. eaves filler strip; 3. tiles; 4. hidden rafter; 5. roof purlin; 6. hold-down beam; 7. upper rafter support.

Fig. 203 Since the curve of the hidden rafters will define the visible roof line, they are carefully placed with the use of a template.

Figure 204 The hidden rafters (visible on the right) are being covered with sheathing boards.

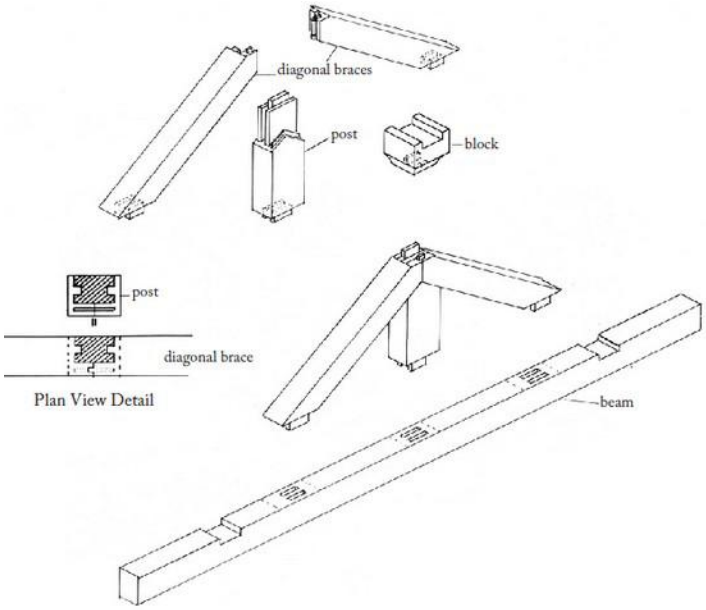


Figure 205 A decorative beam and a strut for a gable. (See also Figs. 57, 70, 210.)

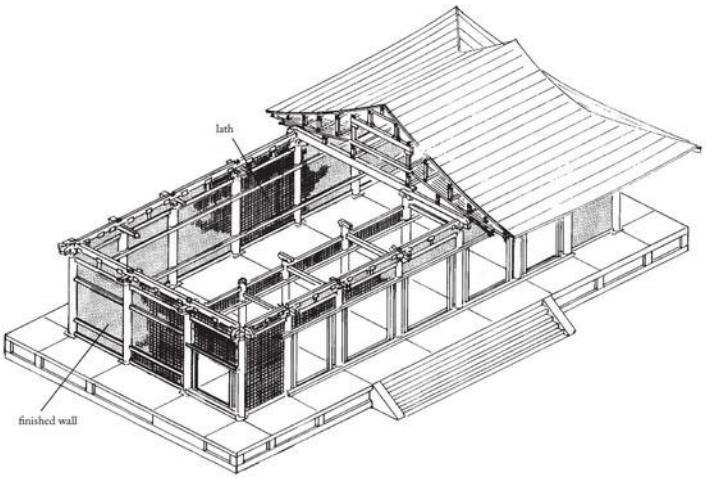


Figure 206 The Picture Hall in the process of wall installation.

WATTLE AND DAUB WALLS

Lath for the clay walls was installed all around the building (Fig. 206). It consisted of a lattice of thin wooden members, which were inserted in shallow mortises in the columns and beams, and wrapped with rope (Figs. 207, 208). This formed a base to which the plaster, a mixture of clay and straw, which had been allowed to ferment for several months, would adhere securely. The clay plaster was applied in several layers of slightly different formulation and allowed to dry thoroughly between coats. The clay layers were applied by hand and the surface coats, a fire-resistant mixture which contained lime, by trowel, which was then polished (Figs. 209-211). The final wall was a hard, gleaming white (Fig. 33).

Figure 207 Lath was installed as a grid of thin wooden strips wrapped with hemp rope.

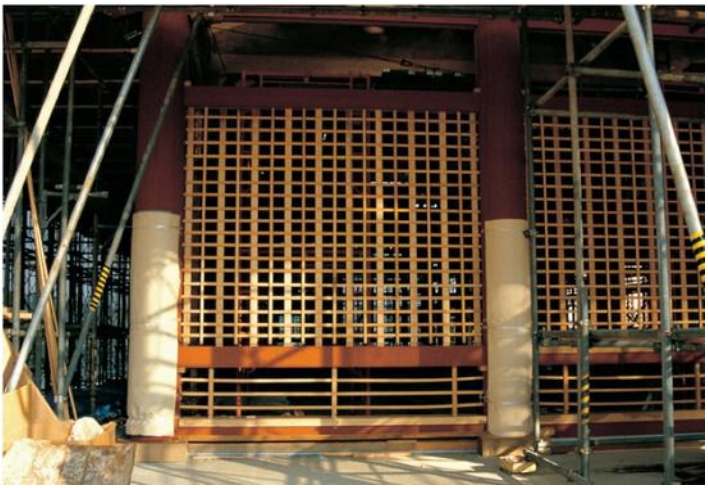


Figure 208 The nearly completed latticework on the western wall.

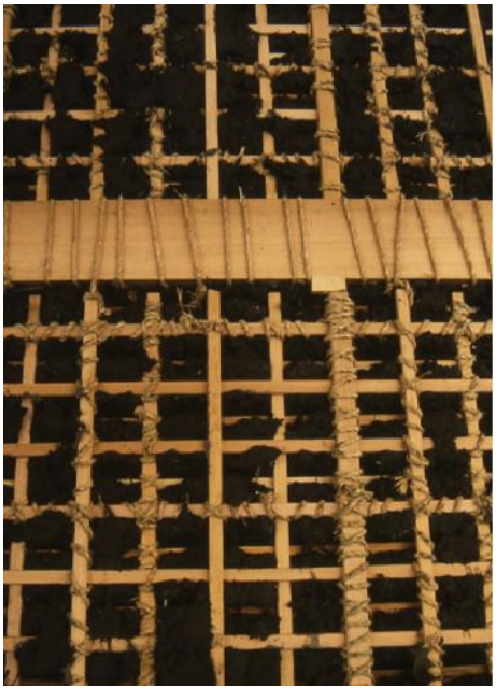


Figure 209 Clay plaster after being applied to one side of the wall.

Figure 210 The gable end after the rough coats of plaster have been applied. The straw, which is used to strengthen the plaster and prevent it from cracking, is clearly visible. The wall was later finished with several coats of hard white plaster. (See Fig. 33.)

Figure 211 Final coats are troweled on, creating a progressively smoother surface.

CEILING

The ceiling of the Picture Hall is a jointed wooden lattice (Figs. 212-214) into which painted boards have been placed. It fits into the penetrating tie beams at the perimeter, and is supported over the center span by suspension rods attached to the roof structure. The grid over the outer zone is smaller than that over the inner zone and is noticeably lower. Hatchways were provided for access.

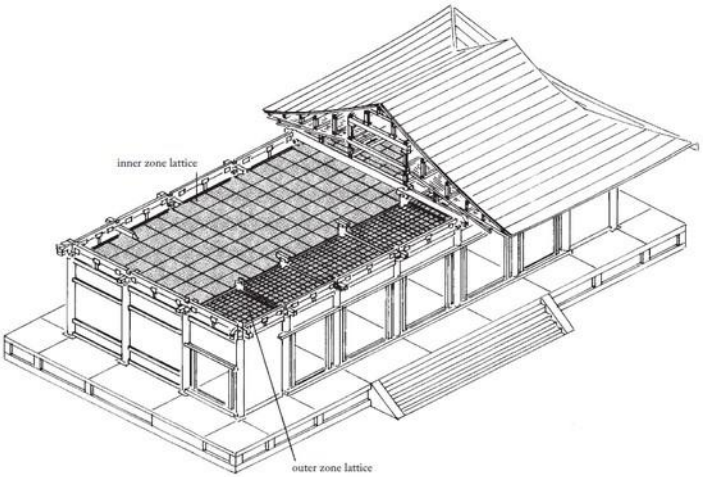


Figure 212 The Picture Hall after installation of the ceiling lattice.

Figure 213 Positioning the ceiling members.

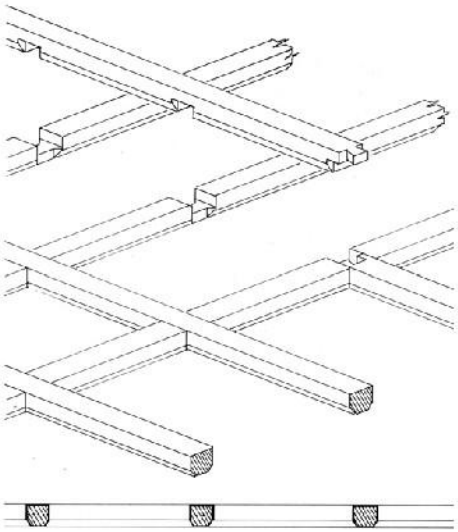


Figure 214 The ceiling is a grid of wooden members (approximately 10 cm square in section), which are jointed at every intersection.

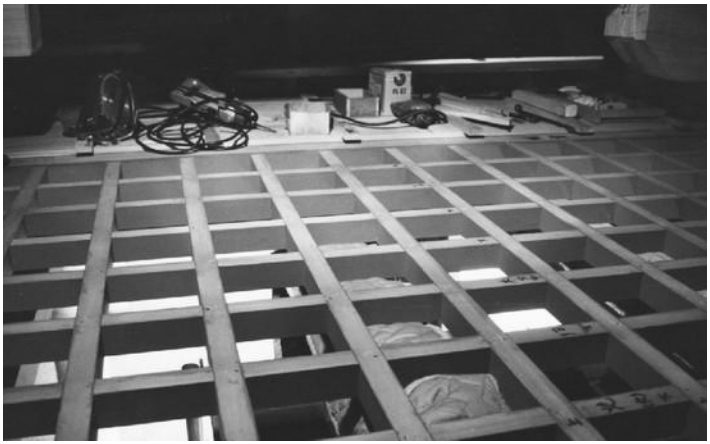


Figure 215 Over the outer zone, no suspension rods are required because of the relatively short span.

EXTERIOR DETAILS

The doors were among the last elements to be added (Figs. 216-219). There are five doorways across the front, and one at each side, positioned to connect with the surrounding corridor. Each doorway has a pair of doors. An individual door has five wooden parts: three thick panels (tongue-and-grooved) and two rails (upper and lower), which lock the panels together. The doors are decorated with thick gilt-bronze strap hardware.

The concrete foundation was completely faced and paved in granite (Figs. 220-222). The facing was applied in a conventional manner, with adhesive mortar and metal straps embedded in the concrete. The paving was laid in a simple pattern, cut on the site to accommodate the column base stones. Mortar was applied dry, leveled, and then wet with a

ladle. The stone was positioned with the help of small shims which ensured even spacing, and more water was applied and allowed to enter the cracks. The stone was tapped with a rubber mallet until perfectly level.

All of the rafters received pierced-work bronze plates on their ends (Figs. 4, 223, 224). Bronze bells were hung from the hip rafters, and bronze bosses were applied to conceal spike heads on the outside horizontal brace beams.

The exterior walls were plastered white (Fig. 33), awaiting the paintings which were to be applied to the interior walls and the ceiling, along with a warm-colored natural tile floor.

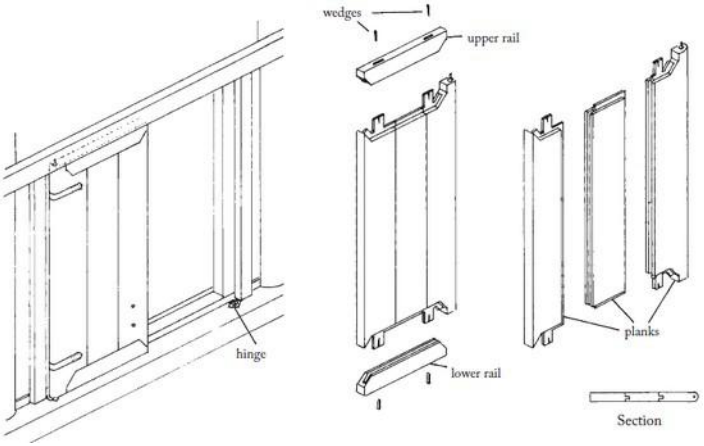


Figure 216 Door assembly. Each door is fabricated from three solid planks, locked together by upper and lower rails.

Figure 217 The finished doors are almost airtight.

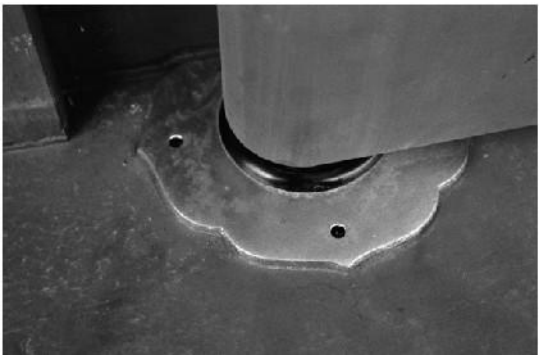


Figure 218 Smooth pivot hinges of gilt bronze.

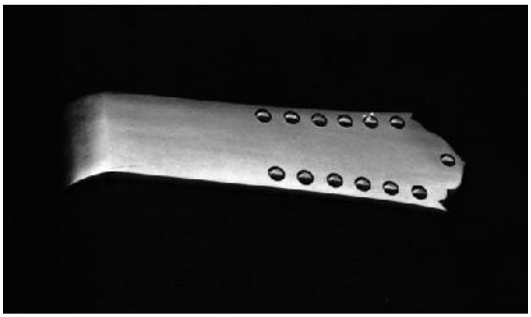


Figure 219 Thick gilt-bronze strapping echoes the traditional hung hinge.

Figure 220 Granite facing and paving stones were among the last details to be added.

Figure 221 The paving stones were set in a thick bed of mortar.

Figure 222 A detail of the paving stones and column base stone.

Figure 223 The gilt-bronze plates are both protective and decorative, and highlight the structural rhythm of the rafters.

Figure 224 Applying gilt-bronze pierced-work rafter end caps.

ROOF TILES

Traditionally, Japanese architecture uses several types of roof tiling systems. The buildings at Yakushiji used a silver-gray tile manufactured nearby, with a decorative pattern taken from the original eighth-century pagoda. This roof required tiles of several different shapes.

The primary tiles are slightly dished rectangles and these were placed in rows side to side, with the upper tiles overlapping the lower ones (Figs. 227-231). Their joint lines

were covered with semi-cylindrical tiles, which overlapped the tiles on either side (Figs. 232-234).

All of the roof ridges were covered by stacked rectangular tiles, crown side up, which were in turn capped by the semi-cylindrical tiles. Large decorative “ogre” tiles and bird perch tiles terminated these groups of tiles (Fig. 238).

Before the modern era, the space between the curve of the roof sheathing and the tiles was often filled with clay, which made the curve of the roof smooth and provided a secure bed for the tiles. At Yakushiji, considerable weight was saved by laying the tiles on wooden battens, fastened in crucial places by nails and copper ties. (Figs. 226, 227, 241). The resultant seal was equally as watertight as the traditional method.

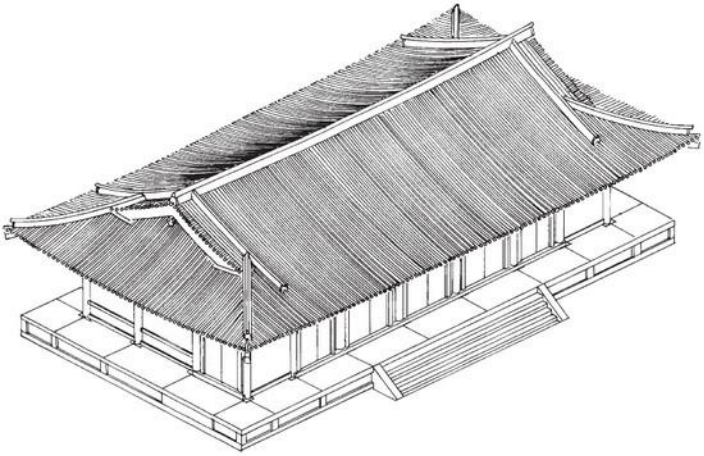


Figure 225 The finished Picture Hall after the laying of tiles.

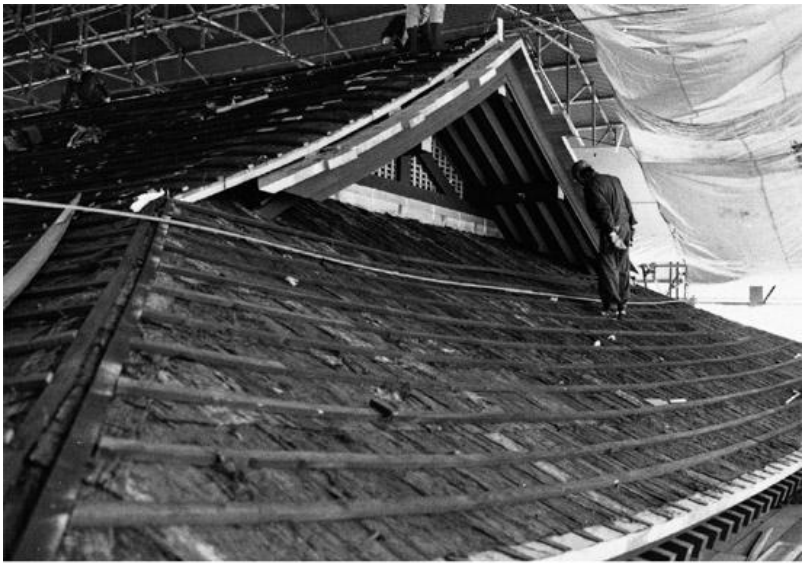


Figure 226 A layer of cedar bark was applied over the roof sheathing boards, and then a set of battens was laid horizontally.

Figure 227 Another set of battens was laid vertically, and a scalloped tile cant strip was added.

Figure 228 The primary eave tiles, which are decorated at the end, were the first to be laid, fastened with wire ties to the vertical battens.

Figure 229 The remaining dished primary tiles were applied row by row.

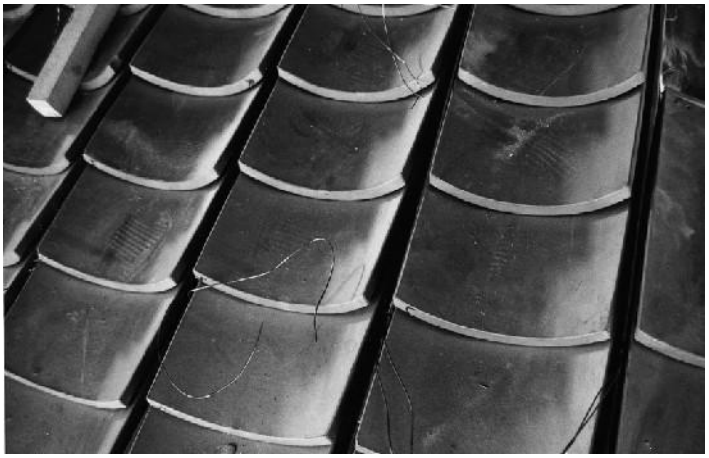


Figure 230 A small gap was left between adjacent rows of primary tiles.

Figure 231 The roof after all the primary tiles had been laid.

Figure 232 The gap between the primary tiles was covered by semi-cylindrical tiles. Those at the eaves are decorated.

Figure 233 The semi-cylindrical tiles were laid so that upper tiles overlapped lower.

Figure 234 Semi-cylindrical tiles in place.

Figure 235 Ridges were formed by stacked, slightly convex tiles set in mortar.

Figure 236 The ridge tiles were held in place with small wooden spacers until the mortar had set.

Figure 237 The ridges were capped with semi-cylindrical tiles. Angled intersections were covered with specially shaped tiles.

Figure 238 The ends of the ridges, flaring upward, were capped with decorative “ogre” tiles as well as a modified cylindrical tile called a “bird perch.”

Figure 239 The cylindrical end tiles, like this one at the peak of the gable edge, have a decorative motif based on the lotus blossom, in a particular pattern associated with Yakushiji since its inception.

Figure 240 The scale and rhythm of the tiles may have its roots in archaic roofs made of bamboo.

Figure 241 The tiles are stamped with a maker's mark. Those in certain locations were tied to the structure beneath with thick copper wire.

CHAPTER 11

THE
RIDGE BEAM CEREMONY

One highlight of the construction process was the raising of the uppermost beam. It was a cause for celebration. True, the job was not entirely finished. A thousand details needed attending to over the following months, but the structure was finally a building. The roof was not yet fully enclosed, but it was a roof, and the spirits could reside beneath it. This is the meaning and purpose of the ridge beam raising ceremony (Figs. 242-249). The old spirits that dwell on the property—be they ricefield spirits or forest spirits—are kindly asked to vacate the premises and are given numerous inducements to do so in the form of food and gifts. The spirits of heaven then lower the ridge beam, suitably adorned, into place. These new deities do not take up residence as yet. That would occur at the formal enshrinement ceremony after everything was really finished. But the building was now a temple.

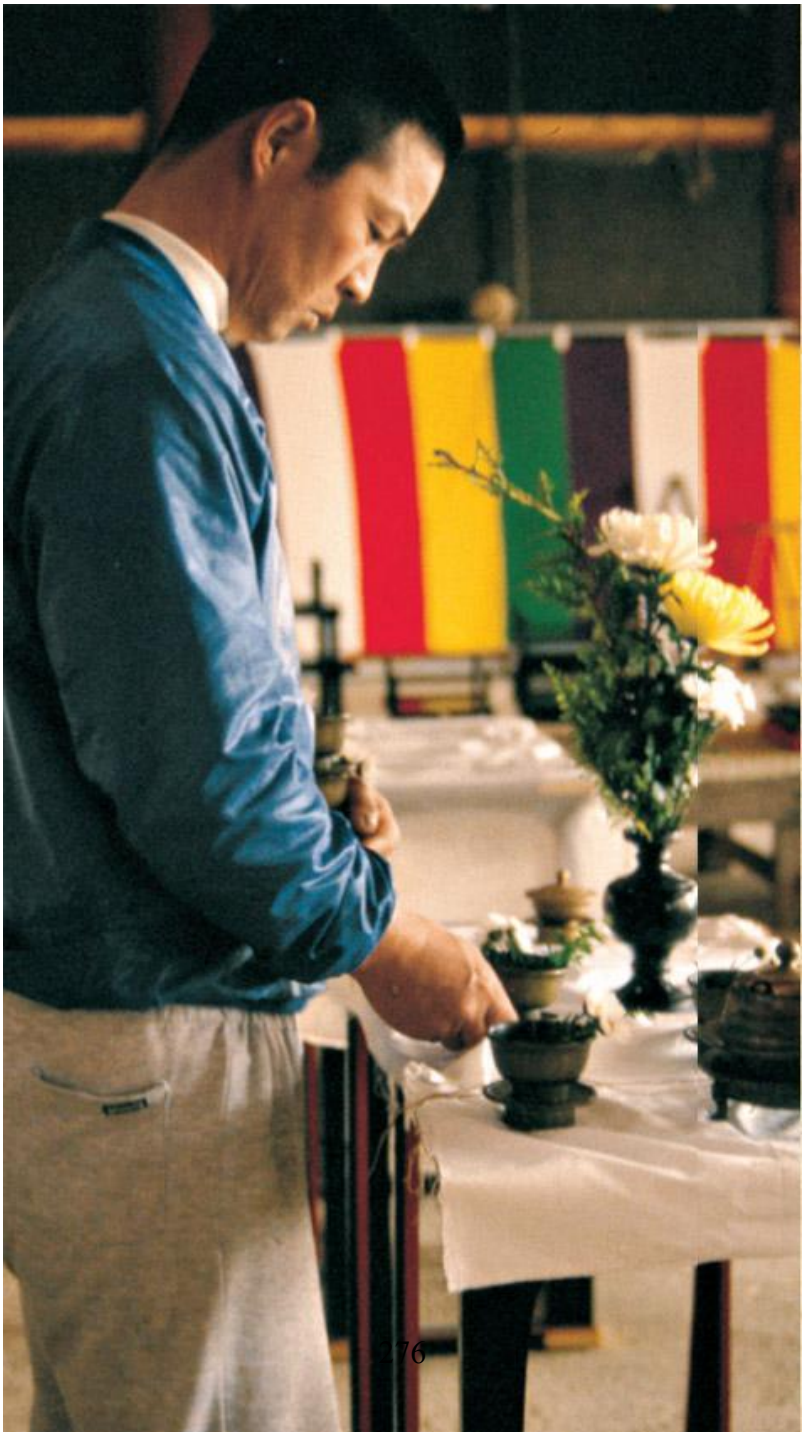


Figure 242 A carpenter arranging flowers on an altar in preparation for the ridge beam raising ceremony.

Figure 243 The ridge beam is symbolically dangled from heaven by three long strips of colored cloth.

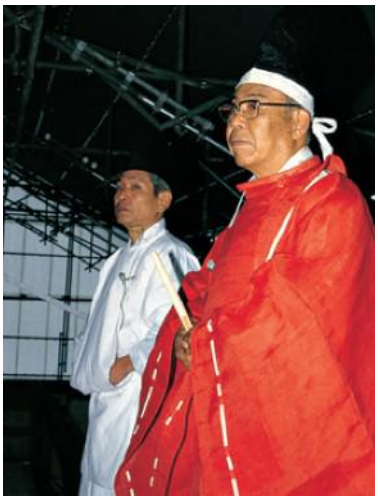


Figure 244 For ceremonies such as this, the Master Carpenter has a ceremonial role similar to that of a cleric.

Figure 245 Special talismans are made and temporarily installed, such as this karimata arrow pointing to heaven.

Given that in Japan there is a peaceful coexistence between indigenous Shintō deities and their imported Buddhist counterparts from China, the ridge beam raising combines practices from both faiths. The carpenters, accordingly, dressed in the vestments of Shintō priests for the day, led by the master in appeasing the Shintō spirits of the earth and wind with songs and gifts. Buddhist priests, meanwhile, read the sutras and made offerings of incense. Then, at the climactic moment, each priest held one end of a long, colored banner, symbolically dangling the ridge beam from heaven, while carpenters above tapped the beam into place with ritual tools made specifically for the occasion. All then retired to an

adjoining hall for a celebratory feast, including copious quantities of sake served for once by the masters to the lowly.

Nowhere, perhaps, can the Japanese carpenter's enthusiasm be felt as keenly as at these celebrations, which rarely occur more than once in a year. Here the mood is jubilant and thankful: everyone concerned congratulating themselves and each other on exacting work well done, and thankful to all—gods, men, and fate—who have provided the opportunity to do work worthy of human beings, worthy of trained craftsmen, and to take part in the sheer joy of building.

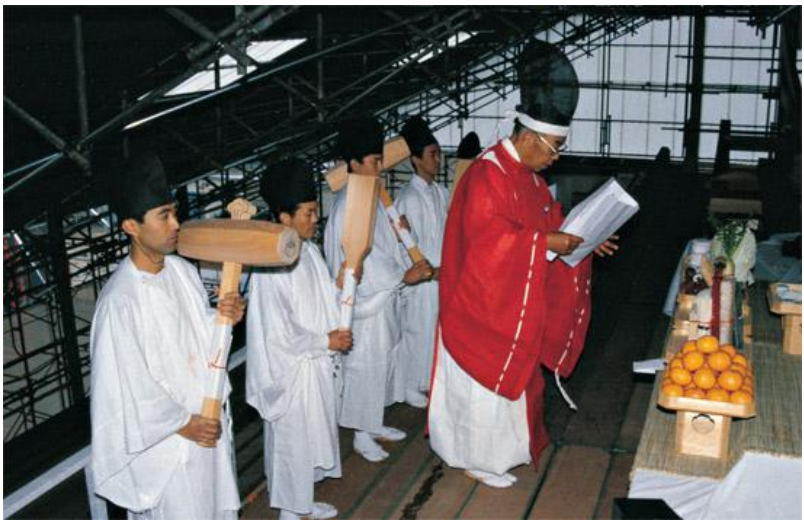


Figure 246 Nishioka, as head carpenter, led the ceremony on the roof while the Buddhist monks waited below. The apprentices wielded ceremonial mallets to "tap" the ridge beam into place.

Figure 247 The offerings included sake, vegetables, rice cakes, and bitter oranges, as well as exquisitely decorated ceremonial tools.

Figure 248 The ceremony concluded, casks of sake were broken open, square wooden cups filled, and the meal began. It was a rare occasion in which the Master served those under him, expressing his gratitude.

Figure 249 The celebration continued for several hours, punctuated by songs, speeches, and the occasional sound of a thoroughly satisfied carpenter slipping inebriated from his chair and hitting the earthen floor with a thud.

FURTHER READING

Coaldrake, William H. The Way of the Carpenter: Tools and Japanese Architecture. Tokyo and New York: Weatherhill, 1991. An extremely well-researched and informative discussion of the development and use of carpentry tools and techniques in Japan from prehistory to the start of the modern era. The author makes excellent use of historical Japanese writings on building and related crafts.

Engel, Heinrich. Measure and Construction of the Japanese House. Tokyo and Rutland, Vermont: C. E. Tuttle, 1985. Extracted from the author's larger work, The Japanese House: A Tradition for Contemporary Architecture, this book has copious illustrations dealing with house planning and construction.

Nakahara, Yasuo. Japanese Joinery: A Handbook for Joiners and Carpenters. Translated by Koichi Paul Nii. Point Roberts, Washington: Cloudburst Press/Hartley and Marks, 1983. A fairly detailed discussion of Japanese carpentry, including joinery, but dealing exclusively with house construction. Still, a valuable book, and the best of its kind in English. Much of the content was later integrated into The Complete Japanese Joinery.

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Ōta Hirotaro, ed. Japanese Architecture and Gardens. Tokyo: Kokusai Bunka Shinkokai, 1966. A fine, detailed introduction to Japanese architecture, with particular attention paid to temple construction.

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(Japan Arts Library, Vol. 9). Tokyo and New York: Kodansha International and Shibundo, 1980. A detailed and thorough introduction to Buddhist architecture from the Asuka to the Heian periods. Much technical information and a bibliography.

Wong, Dorothy C., and Field, Eric M. Horyuji Reconsidered. Newcastle: Cambridge Scholars Publishing, 2008. This is a collection of recent scholarly essays about Hōryūji temple which help flesh out the context in which it was built and shed light on many puzzling aspects. Of particular interest are Field's detailed computer-generated 3D images of Hōryūji's five-story pagoda, which reveal its internal structure beautifully and clearly.

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INDEX–GLOSSARY

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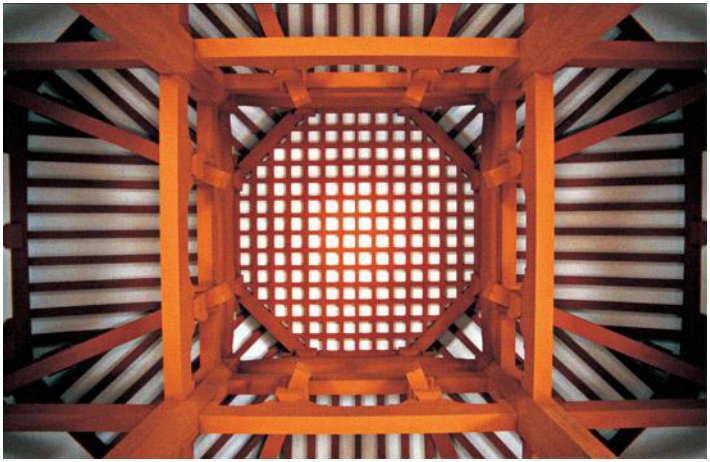

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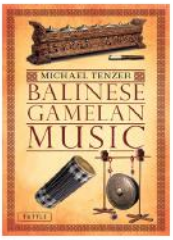

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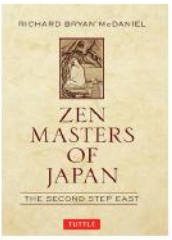

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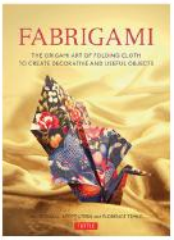

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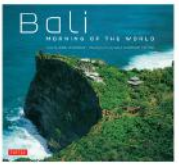

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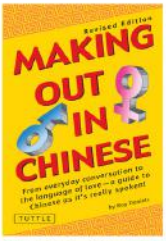
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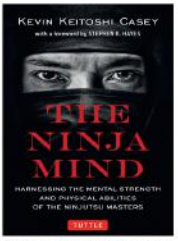
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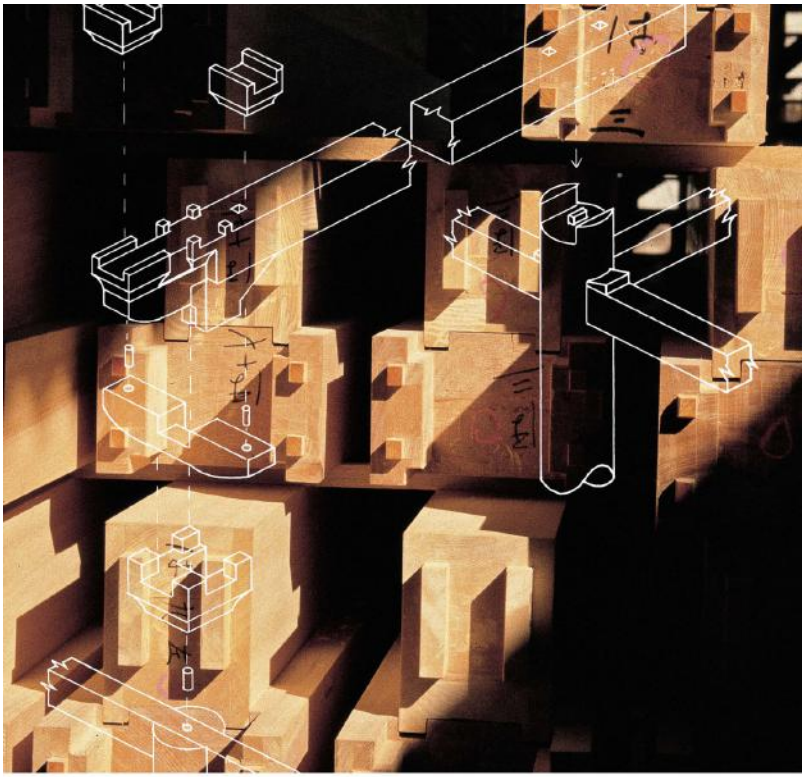

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